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THE INSTITUTE CONVENTION.

The year 1911 is proving a notable one in the matter of electrical conventions. Hardly have the echoes of the great New York meeting of the National Electric Light Association died away before we are called upon to admire and praise the record of the American Institute of Electrical Engineers in Chicago. The Institute convention in the latter city last week was truly a remarkable gathering, not only for its size but for a spirit and enthusiasm unusual in the meetings of a professional society. The registered attendance was 930, which is perhaps even more noteworthy than the record of over 5000 at the recent N. E. L. A. convention, considering the scope and objects of the two organizations and particularly the meager attendance at the Institute annual gathering in recent years. It was very much larger than the attendance at any previous Institute convention and was possibly larger than anybody anticipated. The Chicago convention committee made its preparations on such a liberal scale, however, that the large assemblage was accommodated without difficulty, although it is, of course, true that the total number registered was not present at any one time. The great success of the meeting is an indication of what the Institute may accomplish in other directions under favorable conditions.

Considering the character of the papers presented, one is struck by the attention paid to questions of public policy. Professor Jackson devoted his presidential address to "Electrical Engineers and the Public," saying that while he would not entangle the engineer in "commercialism," he does think that engineers have a special duty as professional men to support right and reason in the dealings between the public and public-service companies. This is something of a departure from the usual presidential address at an engineering convention. Moreover, one entire session, styled the "electric-lighting session," although "public-policy session" would have been a more exact designation, was devoted to the reading and discussion of Mr. Floy's paper on depreciation and Mr. Byllesby's on "The Responsibilities of Electrical Engineers in Making Appraisals." The attention thus paid to matters of political economy is significant of the trend of the times, which was further indicated at a dinner given by the chairman of the entertainment committee, where these problems were vigorously discussed.

An event of more than ordinary interest was the resignation of Mr. Ralph W. Pope, the veteran secretary, who has served the Institute so faithfully and so well for twenty-six years. Fortunately, however, the society will continue to have the benefit of Mr. Pope's counsel and services as honorary secretary, in which capacity he will foster the interests of the Institute sections and branches. Chicago welcomed the convention with open arms. The entertainment features were planned on a lavish scale and carefully carried out. A special word of thanks is due the Electric Club of Chicago for its delightful luncheon. One result of the conspicuous success of the convention will be a possible questioning of the past policy of holding the convention at

summer resorts. A registration of 178 at the White Mountains last year and of 930 at Chicago this year reveals such a great difference in the strength and in the prestige that a convention gives that it is probable that many future conventions will be held in large cities. In the language of the resolutions adopted at the Chicago convention, "The extraordinary success of the Chicago convention, the greatest in the history of the Institute, redounds to the credit of those responsible for its arrangement and attests the suitability of the great metropolis as a convention city."

THE OPERATION OF 100,000-VOLT TRANSMISSION CIRCUITS.

Four papers due to the high-tension transmisssion committee of the American Institute of Electrical Engineers and presented at the recent Chicago convention give a most instructive view of the present state of practice with respect to extremely high-tension lines. There are now, we believe, some half dozen circuits operating at or a little above 100,000 volts, and two of them, that of the Central Colorado Power Company and the Grand Rapids line, have been in successful operation for some time. The present reports pertain to the systems of the Great Western Power, the Southern Power, the Great Falls Power and the Central Colorado Power companies, each of them operating lines exceeding 100 miles of length at approximately 100,000 volts. All have tower lines, with spans from 600 ft. up, and all are equipped with suspension insulators and one or more ground wires, grounded at every tower. All, too, have electrolytic lightning arresters in use. The spanning between the conductors varies considerably, from a little over 8 ft. to 15 ft., and even the shortest distance seems to give entire security so far as insulation is concerned. With regard to the performance of the insulators, it has been uniformly good, break-down of the insulation being an unusual occurrence. The Great Falls plant reports no failures at all, the Great Western Power Company only three or four, and the Southern Power Company only one failure of service during a sleet storm, when some of the insulators gave way mechanically. The first-named plant seems to be particularly fortunate in its insulators, which flash over when wet only at something near 300,000 volts, thus giving a large factor of safety. One of the extraordinary features reported is the very slight coronal effect observed in any of the plants. The secret of the situation is perhaps disclosed by the report from Great Falls, in which case corona was visible on every live part of the system at first, but gradually became less conspicuous as if the points of extreme curvature from which corona would naturally start had been gradually worn away. Possibly, however, something may be charged up to increasing familiarity of the phenomenon, so that discharges which would have been immediately noticed at first failed to attract attention. Certainly at 100,000 volts one must expect coronal discharges, and the reported absence of them in any considerable quantity even on wires as small as No. 6 is a thing which deserves further investigation.

With respect to lightning, the Great Western plant has experienced none, and consequently gives no information. The Southern Power Company's system reports twenty-two shut-downs since Jan. 1, 1910, averaging nearly five minutes of time lost per shut-down. The Great Falls plant reports no shut-downs from lightning, although discharges have taken place over the arresters. Perhaps this immunity may be charged more to good luck and very high line insulation than to anything else, since the lines of the Southern Power Company, which has suffered most, had no less than three stranded ground wires grounded at each tower. The universal experience, however, has been that the 100,000-volt lines suffer no more, and probably less, from lightning than would the ordinary lines at half the voltage. The charging current on these long high-voltage lines is somewhat formidable, running even as high as 6000 kva or 7000 kva. The agreement between the measured and the computed charging currents has proved very satisfactory, so that, although the phenomenon is a very striking one, it is readily prepared for, and on the large systems, which alone can economically use these high voltages, can readily be taken care of by the generators. A plentiful supply of induction motors on the system, of course, tends to neutralize the distributed capacity, so that in the case of the Great Falls Company the power-factor at the generating plant averages 99 per cent. On a large system, therefore, engaged in general energy distribution one may feel reasonably sure that while the charging current looks big, it is unlikely to be an important factor in the practical working of the plant.

Windstorms have caused trouble on only one of these systems so far as the structure of the circuits is concerned. The lines ordinarily do not tend to swing together, so that practically the service has not suffered. As regards regulation, no trouble has been encountered at any of the plants except such as might be expected on a line of any of the ordinary voltages. Looking over the general conditions in all four of these high-voltage systems, it is apparent that the troubles experienced have been not materially greater, perhaps not even so great, as one would ordinarily expect on a line of moderate voltage. Probably the realization of entering a comparatively untried field has caused greater care in factors of safety than would ordinarily be given to a line of lower voltage. Certainly there is nothing in these reports to indicate any particular difficulty in the operation of a transmission service at or about 100,000 volts. It has, in fact, been the universal experience in power transmission that the dangers feared at every material increase in voltage have in large measure vanished upon closer acquaintance with the facts. So long as one keeps up a suitable factor of safety with respect to the voltage employed, and properly increases the distance between the conductors, there is no particular risk incurred in going even so high as 100,000 volts. How much higher it would be feasible to work in commercial practice remains to be seen, but there is assuredly nothing in the experience of the plants now operating at extreme voltage to cause hesitation in pushing on still further when commercial requirements make it desirable.

THE MAGNETIZATION OF TELEPHONE GENERATORS.

One of the most familiar little alternating-current generators in country districts, and one also well known until recent years in cities, is the hand-driven telephone generator for ringing polarized bells. It is closely akin to the

mechanically driven generator used for gas ignition in many an automobile engine. Nevertheless, the average electrical engineer knows less concerning the electric behavior of these familiar and multitudinous little machines than of the fewer large generators used in lighting and energy transmission. An interesting set of external characteristics for one of the above-mentioned types of telephone generators is contributed this week by Mr. H. P. Clausen. Owing to the high internal impedance and armature reaction of such a small machine the internal drop of pressure under load is relatively considerable, and the terminal voltage under load is considerably less than the internal voltage. The generated voltage wave in such a machine is usually very peaked, and with 75 volts root-mean-square generated the maximum is shown to be about 240. It is no wonder, therefore, that the shock capable of being inadvertently received from one of these little generators is sufficient to astonish the recipient.

The principal reason for this remarkably peaked wave is that the armature pole-faces bridge over from one field-pole to the other and so produce a very sudden rise and collapse in the flux linked with the armature coil at the moments when the magnetic short-circuits take place. If the armature were shaped so as to avoid this magnetic short-circuiting there would be a marked cyclic change in the main-circuit reluctance and the residual magnetism in the permanent field magnets would be shaken out much sooner. The phenomena of magnetizing the permanent field magnets are well described in the article. The armature has to be withdrawn during the magnetizing process in order to avoid a heavy magnetic shunting and reduction in impressed magnetic potential. A temporary magnetic short-circuit is then applied to the poles after magnetization until the armature can be inserted permanently. If the newly magnetized field is withdrawn from the energizing without its armature or equivalent shunt across the air-gap the reluctance in the magnetic circuit at the large air-gap is made unduly great. The passage of the residual magnetic current through this external magnetic resistance sets up, on the same principle as with the electric circuit, a correspondingly large external back mmf which soon demagnetizes the field system, whereas when a magnetic short-circuit is applied to the poles, either by means of an external mass of iron or by the armature, the flux encounters only a feeble external resistance and produces only a feeble demagnetizing mmf. All of these phenomena are well known in connection with the magnetization of permanent-magnet measuring instruments of the D'Arsonval type.

It is curious to see by the curve sheet accompanying the article that the external power of the machine reaches a maximum—between 3 watts and 4 watts—approximately at half the maximum current and half the internal voltage. This is the condition that applies to a small, separately excited direct-current generator, which is well known to produce maximum external power when the external resistance is equal to the internal resistance and when half the internal voltage at terminals delivers half the maximum current of short-circuit with an electric efficiency of 50 per cent. The conditions in a telephone alternator armature are, however, necessarily more complex, so that this state of affairs is by no means a necessity.

A BRITISH DISTRICT SUPPLY SYSTEM.

It is strong evidence of the effectiveness of electrical energy transmission to find one of the most striking examples of it in the immediate vicinity of Newcastle, England, in the very heart of the coal district. In another column is an account of the new generating station of the Newcastle-upon-Tyne Electric Supply Company, which operates over a territory of over 1000 sq. miles, having a network for general energy distribution fed by seven stations, with still others under construction. All the stations are, of course, operated from coal, except those utilizing waste heat from coke ovens and other sources. The present station at Dunston is near the further end of the Tyne network, and, as will be seen from the description, is a thoroughly modern turbo-generator station containing now three 10,000-kw generators with arrangements for installing an addition of equal size when necessary. The arrangement of the station is not unlike that of several stations in this country. The boiler house is planned to contain four units for each generator, three giving sufficient steam capacity for the machines so that the fourth can be held as a reserve. They are all mechanically fired and are provided with the usual coal-conveying machinery so that the manual labor is reduced to a minimum. The steam pressure and superheating are about as in American practice. In the turbo-generators, however, there is a marked departure, the frequency being 40 cycles per second, which is a little out of the ordinary even in foreign practice. Its obvious advantage is in the facilities it gives for operating large moderate-speed motors, and perhaps for general service it may be consdered a good compromise between the 60 cycles commonly here used for general electric-energy transmission and the 25 cycles employed where synchronous converters form a large part of the load.

In one respect the Dunston station represents a more extreme design than is yet common here. The switch house, in which all the main switch gear is installed, is some 150 yards away from the engine house, all sides of the house being freely accessible for the entrance of cables. Whether this particular feature will prove successful or not depends very much on the care with which the connections from generators to switch house are installed. Several big American stations have been put out of business for considerable periods within the last year or two by reason of wholesale destruction of cables. In order to obtain security against this particular kind of disastrous accident it would seem to be necessary to install protective apparatus close to the generators, and when this is done a degree of complication is reached which probably offsets any imaginable gains from having an isolated switch house. We are glad to note in some American stations a recurrence to simpler methods of operation in which the switch gear is reduced to something like proper proportion of bulk and cost. The Dunston station has emergency switches, it is true, near the generators, but these are really in fact remote-control connections for the main switches in the switch house, so that the added security is perhaps dubious. Altogether, however, the station is a thoroughly modern and well-equipped one and a valuable addition to the resources of the great network which it feeds.

Federal Suits Against Wire Manufacturers.

On June 29 nine indictments were presented by a grand jury to the United States Circuit Court of Appeals for the Southern District of New York, involving eighty-three officers and employees of companies alleged to have entered into combinations and conspiracies in restraint of trade and commerce among the several states. Notice has been served on the defendants to be present in the Federal Court, New York, on July 10. Judge R. W. Archbald, of Scranton, Pa., a judge of the United States Circuit Court of the Middle District of the United States, has been especially assigned to preside at the July term of the criminal court, before which the defendants will be arraigned.

The indictments are against persons named as members of the following associations: Lead-Encased Rubber Cable Association, Weatherproof and Magnet Wire Association, Telephone Cable Association, Underground Power Cable Association, Fine Magnet Wire Association, Bare Copper Wire Association, Rubber-Covered Wire Association, Wire-Rope Manufacturers' Association and Horseshoe Manufacturers' Association. These associations no longer exist, having been dissolved at various times during the past two years.

In various specifications of each of the nine indictments the name appears of Mr. Edwin E. Jackson, Jr., of the law firm of Noble, Jackson & Hubbard, New York, who is also indicted on two counts in each of the nine presentments. Twenty-six companies which manufacture bare or insulated wire are mentioned, but the indictments as filed are against individuals and not against the companies to which they belong. In every case but one officers of the companies mentioned in the presentments are among those indicted. The exception is the General Electric Company, the name of a salesman and of an assistant salesman only being cited as representing that company in the Rubber-Covered Wire Association. Below is a list of the wire companies which figure in the indictments:

American Electrical Works of Rhode Island, American Steel & Wire Company of New Jersey, Ansonia Brass & Copper Company of Connecticut, Ansonia Electrical Company of Connecticut, Belden Manufacturing Company of Illinois, Benedict & Burnham Manufacturing Company of Connecticut, Bishop Gutta Percha Company of New York, Bradford, Kyle & Company of Massachusetts, Coe Brass Manufacturing Company of Connecticut, Crescent Belting & Packing Company of New Jersey, General Electric Company, Habirshaw Wire Company of New York, Hazard Manufacturing Company of Pennsylvania, Indiana Rubber & Insulated Wire Company, Marion Insulated Wire & Rubber Company of Indiana, Alfred F. Moore, Philadelphia; National Conduit & Cable Company of New York, National India Rubber Company of Rhode Island, New England Electrical Works, New Hampshire; New York Insulated Wire Company, Phillips Insulated Wire Company of Rhode Island, John A. Roebling's Sons of New Jersey, Safety Insulated Wire & Cable Company of New Jersey, Simplex Electrical Company of Massachusetts, Standard Underground Cable Company of Pennsylvania, Wire & Telephone Company of America.

The nine indictments vary little in form and statement, and the following abstract of the presentment against the members of the Underground Power Cable Association will serve to represent all the others. After describing the several manufacturing companies represented in this association and stating that these companies produce 95 per cent of the entire amount of underground cable consumed in the United States, the following offenses are charged against the individuals indicted, fifteen in number, including officers, sales agents and salesmen of four manufacturing companies, and also E. E. Jackson, Jr.:

(a) That the defendants named caused and procured their respective corporations to sell the underground power cables to be produced by them at arbitrary, artificial and non-competitive prices, to be fixed by said defendants from time to time, which prices were greatly in excess of the prices which would have been demanded for such underground power cable but for such unlawful combination and conspiracy.

(b) That they caused and procured their respective corporations to limit the amount of underground power cable to be produced by them to a fixed and arbitrary percentage, to be determined and agreed upon by defendants from time to time, which would be different from the normal and natural amount they would each otherwise produce but for such unlawful combination and conspiracy.

(c) That they caused and procured their respective corporations so to conduct their respective business, trade and commerce as to destroy and prevent all competition between such corporations in said business, trade and commerce.

(d) That they caused and procured their respective corporations so to conduct their respective business, trade and commerce as to injure and destroy the business, trade and commerce in the United States in underground power cables of all persons or corporations other than those with which said defendants were connected, and so as to destroy and eliminate all competition with their respective corporations by any and all such persons and corporations engaged in the United States in such business, trade and commerce.

Specifications under the above charges are detailed as follows:

First: On the first day of June, 1908, the defendants, in furtherance of and pursuant to said unlawful combination and conspiracy, by written articles of agreement, formed and entered into a voluntary association known to and described by them as "The Underground Power Association," which association was to continue until the first day of May, 1911, without the right of any party thereto to withdraw therefrom. By these articles of association the defendants were to hold regular meetings, once every month, in the County and Southern District of New York, and at all such meetings each of the members of the association was to have one vote on all questions to be decided, and the members of said association were to elect an officer to be known as a "supervisor" and such other officers as they might from time to time decide upon.

Second: Immediately upon the formation of the association the defendants elected the defendant Edwin E. Jackson, Jr., to the aforesaid position of supervisor, which position he occupied and the duties of which he thereafter discharged continuously.

Third: Immediately upon the formation of the association the defendants agreed upon, fixed and reduced to writing a set of rules and regulations to be complied with by them and to which they were to cause and procure their respective corporations to comply.

Fourth: Immediately upon the formation of the association the defendants fixed an arbitrary rating for each of the corporations, which rating was established by determining the ratio of the value of the output of the merchandise by each of the corporations to the total value of the output by all during an agreed period of time—the exact period being unknown to the grand jurors—which ratios were known and treated by the defendants as "allotments," which allotments where the percentage bases upon which the corporations were required and compelled to conduct their business.

Fifth: Immediately upon the formation of the association each of the defendants agreed that within ten days after the first day of each month, upon receipt of notice from the defendant Edwin E. Jackson, Jr., as supervisor, to the effect that any of the corporations had taken orders for underground power cable during the previous month in excess of its allotment, the defendants connected with the said corporation would cause such corporation to deposit with Edwin E. Jackson, Jr., 10 per cent

of the value of underground power cable for which orders had been taken during the said month in excess of its allotment, which sums so deposited should be known as a "guarantee deposit," and that if any member of the association should resign, all such sums so deposited by it should be forfeited to the remaining members of the association and should be distributed by the said Jackson to the members of the association who were deficient in their respective allotments.

Sixth: That by the terms of the aforesaid rules and regulations said defendant Edwin E. Jackson, Jr., was continuously the treasurer and custodian of the funds of the said association.

Seventh: That by the terms of the aforesaid rules and regulations the defendants were required, and immediately upon the formation of the association did cause and procure their respective corporations to deposit with the defendant Edwin E. Jackson, Jr., the sum of $5,000, which sum was known and described as a "general deposit," and in the event that any member of the association should withdraw or fail to perform any of its obligations under the articles of agreement or rules and regulations during the period of said agreement it was agreed by the defendants that such sums so deposited should be forfeited and be distributed among the remaining members of the association according to their respective allotments.

Eighth: By the terms of the rules and regulations each of the defendants, on the fifteenth day of each month during the continuance of the unlawful agreement, was required to, and thereafter on the fifteenth day of each month and including the month of April, 1909, they did cause and procure their respective corporations aforesaid to pay to the defendant Edwin E. Jackson, Jr., 1 per cent of the aggregate value of the orders for underground power cable received by said corporations during the previous month, which sums so paid in were deposited by the defendant Edwin E. Jackson, Jr., in the aforesaid general deposit.

Ninth: That immediately upon the formation of the association the defendants, by the rules and regulations agreed upon, established and fixed a schedule of prices at which their respective corporations should sell the underground power cables thereafter to be produced by them, and agreed that the defendant Edwin E. Jackson, Jr., as supervisor of the association, should from time to time fix the base price of underground power cable to be applied to said schedules, which prices so fixed should continue in force until changed by him, and should be observed by the respective corporations and exacted by them and collected from the purchasers to whom they should make sales of such product; and that when any such change should be made by the supervisor prompt notice thereof should be sent by him to all of the defendants and to their respective corporations.

Tenth: Immediately upon the formation of the association, and as a part of its rules and regulations, it was agreed among the defendants that each of their respective corporations should daily mail to the defendant Edwin E. Jackson, Jr., a report showing the various orders and contracts for underground power cable which the corporation had received that day for shipment from its factories, giving the name of the customer, and, in case of contracts, the time of delivery; and from then continuously, every working day until the first of April, 1909, the defendants caused their respective corporations to make such daily reports to Edwin E. Jackson, Jr.

Eleventh: In compliance with the aforesaid rules and regulations, the defendant Edwin E. Jackson, Jr., from day to day and every working day continuously from the first day of June, 1908, to the first day of April, 1909, caused to be made up statements showing the value of the total orders on hand as shown by the aforesaid daily reports made to him, and sent the same to each of the corporations, which reports showed the total value of orders received by all of the corporations and the percentage of such orders received by each corporation.

Another article specifies the date of one of the meetings held by the association. The dates of meetings thus specified range for the various associations from Aug. 11, 1908 (Bare Copper Wire Association), to March 2, 1910 (Fine Magnet Wire Association).

The several indictments conclude with the arraignment of the individuals mentioned in the presentment, under two counts. The first count charges them with unlawfully engaging in an unlawful combination and conspiracy in restraint of trade and commerce among the several states. The second count charges them with unlawfully and knowingly attempting to monopolize the business, trade and commerce in the United States in the commodity covered by the association to which they belong.

Amendments to N. E. L. A. Constitution.

The National Electric Light Association has published a number of amendments to the constitution of the body as adopted at the recent New York convention. One of these broadens the scope of the company geographic and national special sections by rendering eligible to membership in these any person interested in the central-station industry who is proposed and recommended by any class A (central-station company) member in the territory in which the applicant resides. Another amendment relates to the executive committee, the membership of which now consists of the president, two vice-presidents, the retiring president and nine elective members, each of whom shall have one vote; in addition, the presidents of geographic sections and chairmen of national special sections shall be entitled to attend all meetings of the committee, the former collectively having two votes and the latter one vote. The object of this amendment is to permit the geographic and national special sections to have their president or chairman attend all meetings of the executive committee and also to insure that the control of the committee shall not be taken away from representatives of class A members. In order to permit the affiliation in the future of electrical associations that may be located in any section of North America an amendment provides that upon application of five class A members, or two-thirds of such members if less than eight, in any geographic section of any country in North America, the executive committee shall authorize the requested organization of a geographic section. Other geographic sections formed may also be admitted by the executive committee.

Convention of Association of Railway Telegraph Superintendents at Boston.

The thirtieth annual convention of the Association of Railway Telegraph Superintendents was held at the Hotel Brunswick, Boston, Mass., from June 26 to 30. Vice-president J. B. Sheldon presided and there was a total attendance of about 130 persons, including nearly fifty ladies. A notable feature of the convention was the welcome extended to the delegates by Mayor Fitzgerald of Boston, which included the singing of "Sweet Adeline" by His Honor amid tumultuous applause. The social program included various automobile trips for the ladies, a special railroad night at the "Pop" concerts of the Boston Symphony Orchestra, and trips to Old Orchard Beach, Maine; Revere Beach, Mass., and Plymouth, Mass. A strenuous business program was also handled, including the following papers:

Some Hints, Insulators, etc., by Mr. W. J. Camp, Canadian Pacific Railway, Montreal, Canada; *Railway Efficiency*, by Mr. R. W. Pope, New York; *Line Conductor Requirements for Telegraph Transmission*, by Mr. Frank F. Fowle, Chicago; *High-Speed Automatic Perforators or Receivers*,

by Mr. William Mauer, Jr., New York; *Co-operation Between Railroad People and Commercial Companies,* by Mr. W. P. Clive, Wilmington, N. C.; *Economy in the Telegraph Department,* by Mr. William Bennett, Chicago; *Some Observations on Telephone Transmission,* by Mr. J. L. McQuarrie, New York; *Current Supply for Selective Telephone Systems,* by Mr. W. E. Harkness, New York; *Development of Telephones for Train Dispatching and Other Railway Purposes,* by Mr. G. K. Heyer, New York.

An important feature of the convention was the presentation and acceptance of the report of the committee on high-tension line crossings, headed by Chairman G. A. Cellar, of the Pennsylvania Lines, West. This report was prepared in conjunction with committees of the National Electric Light Association, American Electric Railway Association and American Institute of Electrical Engineers.

Meeting of Electric Vehicle Club.

At the regular weekly meeting of the Electric Vehicle Club of Boston on June 28 Mr. Day Baker, of the General Vehicle Company, Boston, presided. The committee on signs announced that plans are being drawn by the construction department of the Boston Edison Company for large electric-vehicle signs to be erected at Mattapan and on the Revere Beach Parkway. The location is being considered of a large animated sign which will exhibit alternately a pleasure and commercial vehicle in operation. Agents of various dealers were requested to supply the advertising committee with photographs to be used in the preparation of lantern slides of electric-vehicle development for exhibition in talks before the public. Mr. E. S. Mansfield stated that in the past eight weeks an average of at least one new public charging station per week for electric-vehicle service had been established in the Boston Edison territory.

Mr. W. E. Eldredge, Boston, reported that all the railroad and steamship companies in Boston have now given consent to the use of their docks and terminals by electric vehicles. Gasoline machines are debarred from practically all such installations. It was recommended that all electric vehicles be suitably marked, so that no time would be lost in passing watchmen at docks and terminals. It was announced that Fire Commissioner Daly, of Boston, is making determined efforts to keep gasoline vehicles from being stored in the heart of the business district. Electric vehicles have the complete approval of the commissioner, and can be stored in buildings anywhere in the business center of Boston. Mr. Mansfield distributed a bulletin showing the names and addresses of various prospective electric-vehicle users who have sent inquiries to the company apart from the lists given to the company privately by dealers. The importance of standardizing garage practice was touched upon, and the meeting closed with a short talk by Mr. F. N. Carle, the newly appointed publicity manager of the General Vehicle Company.

German Association for the Promotion of the Use of Electricity.

An undertaking was organized in Berlin the latter part of January which is of the greatest importance for the entire electrotechnical industry, not only for the manufacturers of electrical apparatus, but also for the central stations. It has to do with the establishment of an association for promoting the uses of electricity. This undertaking is patterned after a similar organization for the promotion of the gas industry that was organized in Germany last year, and it intends to give the electrical industry wide publicity.

The carrying out of this campaign will require the co-operation of all the branches of the industry, so as to bring out the many advantages of electrical energy, such as convenience, cleanliness and hygienic qualities. Along these lines, naturally, there will be a rivalry with the gas association, the propaganda of which is already attaining marked success. It will lie with the executives of these organizations to adopt a policy with reference to the competition between gas and electricity which will result in no harmful reactions to either.

The duty of this new organization lies not only in instructing the public as to the value of electrical energy for lighting, for heating and for motor service, but it should show ways and means of organizing a suitable propaganda for the manufacturers of electrical apparatus and especially for the central-station manager.

The important points for the association to take up are the rate question and lessening the cost of electrical installations. Even though the operation costs of gas lighting and electric lighting with metallic-filament lamps so nearly approach each other, it is a fact that in small and medium size houses electric lighting has come into very limited use. In all large cities even the smallest houses are piped for gas, only a few of the medium size and large houses being equipped for electric lighting. Even when houses are wired for electricity it is often the case that the tenant is obliged to change the installation in order to answer his special purposes. In order to alter the present conditions certain changes must be brought about. The high meter rents must be abandoned and the practice of requiring a minimum consumption must be given up if progress is to be made in introducing electrical energy into the small house. All these are questions which must be taken up by the organization. Special attention will be given to electrical cooking. Here the industry must step in and help by improving and cheapening the electrical cooking apparatus.

Exhibit of Electric Cooking and Heating Devices in Berlin.

As the leader in the movement, choice has fallen on Mr. Einar Wikander, who is known through his articles on the popularizing of electric lighting. He was formerly a director of the Guttenberg central station and later director of the German Incandescent Light Company. He began his duties on Feb. 1, 1911.

In the board the following societies are represented: Vereinigung der Elektricitäts Werke, Der Vorband Deutscher Elektrotechniker, Vereinigung Deutscher Elektricitäts Firmen, Vorband der Elektrotechnischen Installations Firmen in Deutschland, Verein zur Wahrung Gemeinsamer Wirtschaftsinteressen der Deutscher Electrotechnik.

As members of the new organization are eligible owners, central stations, societies and individuals who are interested in the applications of electricity. The headquarters are at present in Berlin—Schöneberg, Salzburgerstrasse 14.

Convention of the Mississippi Electric Association.

The third annual convention of the Mississippi Electric Association was held in the Great Southern Hotel, Gulfport, Miss., June 20, 21 and 22. The meeting was most successful, the total registration of 116 being double that of last year. The sessions, which were held in the Rose Trellis Garden of the hotel, were presided over by Mr. J. Abbott, of Jackson, Miss., the vice-president of the association, President S. W. Greenland, of Columbia, Miss., being unable to be present. At the opening session Judge J. H. Neville, of Gulfport, delivered an address of welcome, eulogizing the city and the manager of the local lighting company. Following the response by the vice-president Mr. A. H. Jones, of McComb, Miss., secretary of the association, announced the entertainment features of the convention as follows: A sight-seeing trip for the ladies in the afternoon and a reception and dance in the evening. On June 21 there were shopping tours arranged for the ladies, and in the afternoon there was a trip to Beauvoir and Biloxi over the lines of the Mississippi Coast Traction Company. In the evening there was a banquet tendered by a number of Southern electrical jobbers to the association and its guests. On June 22 an excursion was provided to Ship Island by boat by the Interstate Electric Company.

The real business of the convention began with the afternoon session on June 20. The first paper on the program was written by Mr. A. B. Paterson, of Meridian, and read in his absence by Mr. Knight.

RELATION OF EMPLOYEES TO THE COMPANY AND PUBLIC.

In his paper Mr. Paterson made an analysis of an employee's duty to his employer and to the public. An employee, he said, should remember that from the company he is receiving his livelihood and that upon its prosperity depends his. If he renders satisfactory service his prospects will be bright. Satisfactory service means loyalty to the company, a thorough knowledge of duties and diligent application to the same, and sufficient interest in the operation of the company to inform other departments of deficiencies. Moreover, there should be no hesitancy in making suggestions having for their object the betterment of the service. Each employee should have a thorough knowledge of the conditions of the company's franchises, of the city code, of what a corporation consists and its proper position with reference to the public. Regarding the second phase of the subject, Mr. Paterson said that employees should not forget that they owe their employment to the public. The company has been granted the privilege to perform an essential service and stockholders eventually expect interest on their investment. The idea that public sentiment can be disregarded or in any manner overlooked has long been outgrown. Some of the important duties which would tend to maintain friendly public relations were given as follows: Pleasant reception of complaints; prompt handling of complaints; satisfactory adjustment of complaints; true statements as to the cause of any deficiencies and when they can be remedied, and polite and intelligent replies to all inquiries. The most valuable man to his employer, Mr. Paterson maintained, is he who places the corporation which he represents in a better light with the public.

The paper was discussed by Messrs. W. F. Gorenflo, Gulfport; J. B. Moorman, Vicksburg; C. Z. Stevens, Hattiesburg; W. G. Clark, Jackson; W. R. Herstein, Memphis, Tenn.; H. Crittenden, Greenville; Percy Stern, New Orleans, La.; I. H. MacArthur, Meridian, and C. E. Reid, Agricultural College. Mr. Gorenflo said his company's affairs were supervised by a railroad commission, but that it welcomes complaints in order to find out defects in its service. Mr. Moorman's company has men on duty to look after complaints, which are given prompt attention. Mr. Stevens said that since the first of the year his company has been under a commission form of government and finds it quite a relief. Mr. Herstein stated that it is the endeavor of his company to instil into the minds of its employees the fact that when complaints arise the customer is not always to blame. It is worse to lose a customer's good will and business, he said, than a few cents in dispute. His company settles a great many claims which it believes are unjust, but it is policy to do so and pays in the long run. He mentioned the plan of a company which gives each employee 1 cent an hour for a period of three months if he is not involved in an accident or trouble of any character. This company has recently distributed $3,500 among its employees and intends to continue the scheme. Mr. Crittenden also felt that his company went farther than it should in settling disputes with the public, but that inasmuch as its revenue was derived from the public no fault could be found.

ELECTRIC-HEATING APPLIANCES.

The second paper to be delivered was prepared by Mr. H. J. Mauger, of the General Electric Company, and was presented by Mr. L. Callender, of the Atlanta (Ga.) office. The author advised an enthusiastic exploitation of heating devices, stating that the bulk of heating-device revenue comes from the residence customer, and will thus develop the residence business. Statistics show that residence business has been neglected; not more than 15 per cent of the residences within reach of central-station service are connected. The author advised house-wiring campaigns on the instalment plan and in co-operation with the electrical contractors, stating instances where such had been very effective. The progressive central-station man realizes, he said, that the more cords by which he can bind the public to him the more indispensable his organization becomes to the community.

As to the amount of money that can be profitably spent for this new-business getting, it was stated that 5 per cent of the gross annual income has often been well spent, half being spent for salaries and commissions to employees and the balance for the various kinds of advertising and publicity. Some central stations spend from $1 to $2 to secure business which will earn $4 gross per year. The author advised selling devices at a profit.

A long discussion followed the reading of the paper in which Messrs. S. M. Jones, Laurel; A. H. Jones, McComb; L. Callender, Atlanta, Ga.; O. A. Acuff, Meridian; W. B. Moorman, Vicksburg; W. F. Gorenflo, Gulfport; J. Abbott, Jackson; A. W. Starliper, New Orleans, La., and others joined. Mr. S. M. Jones stated that his company sells irons at cost, and that in selling heating devices the solicitor should appeal to the women rather than to the men. The increased earnings in small central stations must come from such apparatus as electrical heating devices. The first cost of much of the apparatus he felt was too high. Mr. A. H. Jones, whose company operates in a town of less than 5000 inhabitants, said that about 80 per cent of the company's customers use electric irons. Toasters and coffee percolators are also in use. Two-burner stoves were also introduced and installed at cost, payment being allowed on instalments after a thirty-day trial. At present six stoves are in use, but Mr. Jones believes that he will have from fifty to sixty installations within a year. The prices for ranges are too high, and he felt confident that if the cost were from $30 to $35 for a complete range he could dispose of many of them. The rate on a separate meter for cooking is 5 cents per kw-hour less 10 per cent for prompt payment. The two-disk stoves consume about 1750 watts and, although on a separate meter, the income is only about $1.50 per month, his company is optimistic of results to come. McComb has no gas. Mr. Moorman stated that in Vicksburg almost all of the flatirons sent out on trial remain in service. His company also disposes of a number of sewing-machine motors during the year. Mr. Gorenflo's company pushes flatirons and has been able to install them in every Chinese laundry.

STEAM TURBINE.

Mr. Edmund Dreyfus, of the Westinghouse Machine Company, spoke on the steam turbine in a general way. He referred to the simplicity of the turbine and its economy and possibilities. His paper was not prepared in advance and he spoke from notes serving as an introduction to a general discussion on the subject. Mr. D. D. Ferris, Atlanta, Ga., asked a number of questions, which were answered by Mr. Dreyfus, but other than that there was no discussion on the paper.

NECESSITY OF A COMMERCIAL DEPARTMENT.

A paper on this subject was read by Mr. A. H. Jones, of McComb, who spoke of conditions as they are in Mississippi, where the increases in the use of electricity have not lightened the manager's burdens. Because of this a new-business department is almost unknown. He will take what new business comes to him, but has no time to wage an energetic campaign to get all the business legitimately belonging to the company. This condition exists to-day in nearly all the larger towns in Mississippi. With one or two exceptions it is probably true that no consistent and successful new-business campaigns have ever been undertaken in Mississippi. By this is meant that no such campaigns have been given the sole thought of an able, aggressive commercial man. The possibilities in any community have not been exhausted and it would therefore seem that there should be the courage and conviction to pursue the possibilities until they are captured, for when this is accomplished other opportunities will present themselves, so that an aggressive commercial department need have no fear of ever reaching the saturation point. Some of the latent possibilities that a good commercial department brings into active existence are motors, flatirons, electric signs, cooking and heating appliances, especially where gas is not available. The commercial department enables the influence of the company to grow and creates a new impression of the purpose of the public utility. A review of conditions existing to-day suggests these thoughts to the author of the paper. The original organizations have outgrown their usefulness. The stability of the business demands that additional sources of revenue be provided for two reasons, the enhancement of the earning capacity of the plant and the necessity of rendering to the public generally that service which the company is morally bound to give by virtue of its franchise. With the present organizations overburdened and necessitating changes there remains but to reorganize and in the reorganization create a new department to have charge of all new business and the proper care and handling of the old business.

In the discussion which followed the reading of the paper it was evident that few companies in Mississippi have established new-business departments. Mr. H. Crittenden, Greenville, said his company has just organized such a department. Mr. Moorman, Vicksburg, touched on the necessity of keeping in touch with contractors and architects, stating that his company was gratified with results obtained through maintaining cordial relations with contractors and architects, all new buildings in Vicksburg being equipped with electric wires. Mr. O. A. Acuff, Meridian, gave his experiences with the new-business department in that city and stated that a company can create a better feeling with such a department than in any other way. Solicitors come in contact with customers, hear their complaints and establish friendly relations. Others contributing to the discussion were Messrs. W. F. Gorenflo, S. M. Jones, J. Jumonville, Hammond, La.; E. E. Esslinger, Hattiesburg, and C. Z. Stevens.

A paper on the economy of a 750-kw engine was to have been read at the session on June 21, but the author was unavoidably detained and a lecture by Mr. Karston, of the Holophane Company, was given instead. Owing to the limited time the lecture was greatly curtailed.

EXECUTIVE SESSION.

At the executive session held in the afternoon of June 21 the following officers were elected: President, Mr. Jack Abbott, Jackson; vice-president, Mr. R. B. Claggett, Greenville; secretary-treasurer, Mr. A. H. Jones, McComb; executive committee, the above officers and Messrs. W. F. Gorenflo, Gulfport; W. B. Moorman, Vicksburg; C. Z. Stevens, Hattiesburg, and S. M. Jones, Laurel. Invitations were received from Vicksburg and Hattiesburg for the next convention, but choice of the convention city will not be made until after the first of next year. At the executive session a paper was presented by Mr. J. Abbott on the "Economical Care and Maintenance of Street Cars," and there was a discussion on the Question Box. Notes on both these topics are not available for publication.

Convention of Society for the Promotion of Engineering Education.

The Pittsburgh meeting of the Society for the Promotion of Engineering Education was held June 27, 28 and 29 at Carnegie Technical Schools and the University of Pittsburgh. The attendance was good and a spirit of co-operation and enthusiasm prevailed. On account of the location of the convention in the Pittsburgh district a successful effort was made by the local committee to show the relation of the industries to the education of the young people of the locality. Trips of inspection to a number of manufacturing plants, therefore, formed an important part of the program.

ENGINEERING ENGLISH.

The Tuesday morning session opened with two papers on English, a subject to which the society has properly devoted a great deal of attention. Prof. S. C. Earle, of Tufts College, described original plans which he has used in training engineering students in technical writing. He advocates special drill in English for these students, but he also regards general training in English as an integral part of a technical education. He does not, however, cling to traditional methods of instruction as do some instructors who, in Professor Earle's words, "regard English as the last bit of salvage from the arts course remaining in the engineering school and as the only means of culture in a curriculum otherwise hopelessly practical." The art of clear expression involves clear thinking, especially if the description relates to other than visual images and symbols. Hence, if a student can be taught to write so as to impart accurate information he has been trained in thinking, which is, after all, the real function of a technical education. Following Professor Earle's paper, another of somewhat similar character was presented by Prof. F. N. Raymond, of the University of Kansas, on the preparation of written papers. He emphasized, as the essentials for success in technical writing, (1) accurate and thorough observation, (2) clear perception of other men's viewpoints, (3) correlation of ideas, and (4) good workmanship. By writing reports with these elements in mind an improvement will result whether the instruction is given by the department of English or formally by no department at all. In the discussion following these papers Prof. J. M. Telleen, of Case School, referred to logic as the basis of all work in English and every other subject. He defined rhetoric as "expression with the highest efficiency." Mr. William Kent believed that English can be taught best to engineering students in the engineering school and that engineering reports should be the basis of study of "engineering English."

INDUSTRIAL TRAINING.

Several speakers at the Tuesday and Thursday sessions emphasized the close connection which must exist between theoretical training and practical work. A recent interesting experiment at the University of Missouri was de-

scribed by Profs. H. Wade Hibbard and H. S. Philbrick. They have attempted to teach the principles of scientific shop management by means of the engineering school shops. These shops have been organized as "management laboratories" and work has been put through them in accordance with the modern methods of "efficiency engineering." The experiment is so recent that only preliminary results could be reported, but apparently the students have entered into the spirit of the plan and are profiting by it. A paper based on a wide experience with technical graduates was presented by Mr. E. B. Raymond, vice-president of the Pittsburgh Plate Glass Company, under the title "The Technical Graduate from the Point of View of the Manufacturer." It was appreciated by the society because of the intimate knowledge of human nature which it exhibited. Mr. Raymond said that "it seems to me absurd to expect a college in four years to turn out men freed from their natural weaknesses when one considers the quality of the average human being who enters." Among these weaknesss he mentions laziness, disinclination for practical work, lack of seriousness and ability to assume responsibility, and lack of ability to become a part of a workingman's life. He believes that less "good time" and more "office atmosphere" would improve the college life. He gives as the requisites of success in engineering character health, ambition and specific training.

Messrs. C. F. Scott and C. R. Dooley explained to the society a new plan for adapting technical graduates to the electrical business. The Westinghouse Electric & Manufacturing Company has modified the apprentice plan which has been used for some years by dividing the two years of its apprentice course into two periods. In the one period a more thorough but less extensive shop training will be given and this will be supplemented by classroom instruction. In the other period some one specialty will be taken up and mastered by each apprentice. The University of Pittsburgh is introducing a co-operative plan involving four twelve-week periods per year for four years. The first and last years will be spent in school, but during the second and third years the student will spend alternate periods of three months each in shop and in school. Dean F. L. Bishop hopes by this plan to meet the criticisms of the technical graduate from the standpoint of employers in relation to their immediate adaptability to industrial conditions.

COLLEGE BUILDINGS.

The technical schools of the country are at present very active in securing new buildings and equipment and in improving present facilities. Hence two papers by Prof. J. M. White, of the University of Illinois, dealing with engineering buildings and the college campus, were well received by the society. These papers were supplemented by Director A. L. Williston's description of the buildings of the new Wentworth Institute, a modern trade school in Boston. Professor White discussed "the general considerations which should govern the planning and arrangement of the different types of buildings which are essential for conducting the work of a modern engineering school." He gave the results of a study of the areas required for laboratories, shops and classrooms. He considers the electrical building of the Worcester Polytechnic Institute as the best example in this country of a building well adapted both to its needs and to the architectural requirements imposed by its environment. In the discussion there occurred a lively tilt between the architects and the engineers to decide the relative authority of the architect and the faculty in determining the form of building for engineering instruction.

TEACHING MATHEMATICS.

An important feature of the Pittsburgh meeting was the reception of the report of the committee on the teaching of mathematics to engineering students. This committee was appointed four years ago by the American Mathematical Society and the American Association for the Advancement of Science and it was directed to report to both the American Mathematical Society and the Society for the Promotion of Engineering Education. The first purpose of the committee was to compile statistics regarding mathematical instruction in technical schools, but later the plan was changed to the present one. The report, as presented and, fortunately, accepted, comprises syllabi of the essential elementary mathematical subjects, algebra, trigonometry, geometry, analytical geometry and differential and integral calculus. The plan included a syllabus of "dynamics" or theoretical mechanics, but this was found impracticable for this year on account of lack of time to secure agreement as to the essentials of this subject. The report is an outline of the theorems which every engineering student should know well and which a professor should be justified in assuming as a reasonable mathematical preparation for his work. The committee believes that this is an adequate average preparation, but that if more advanced mathematics is needed in particular courses this should be taught in connection with those courses. Before accepting the report the society debated a number of details, such, for example, as the necessity for including vectors and complex quantities. These subjects were desired by the electrical engineering teachers and others. In accepting the report it was ordered published in the *Proceedings*, where it will be available for general use about Jan. 1, 1912. The report appeared in full in recent numbers of the *Bulletin* of the society.

ENTRANCE REQUIREMENTS AND METHODS OF INSTRUCTION.

The standing committee on entrance requirements presented a revised report with specifications of the several subjects in the required list and a number in the elective list. The discussion preceding the acceptance of the report indicated substantial agreement on essentials and a tendency to limit the number of elective subjects. The members of the society wish to encourage the secondary schools to limit their instruction to what they can teach thoroughly and to give such courses as will fit the graduates for usefulness whether they go to college or not.

Several papers dealing with details of instruction composed the remainder of the program. Mr. H. A. Gehring, civil engineer in the New York State Engineer's department, urged the use of logarithmic diagrams in laboratory work. He believed that much better work can be accomplished by students if they check their results as their experiments proceed. Profs. W. A. Hillebrand and S. B. Charters, of Leland Stanford University, told of their experiences in trying, by means of general lectures. to interest freshmen in the broad field of engineering. They expressed some disappointment that students do not take more interest in the important matters, preferring the "social attractions of a Friday night to a meeting of the San Francisco Section of the Institute." However, the attempt to interest the students in the best things has resulted beneficially to students and faculty alike. Prof. E. B. Paine, of the University of Illinois, gave an extended outline of the methods of electrical engineering instruction employed there. He showed that from a general treatment of the whole subject the instruction becomes more analytical as the work progresses. He lays great stress on mathematical theory, preferring, if necessary, to leave the more practical information to be acquired after graduation. Dean W. G. Raymond, of the University of Iowa, renewed his plea of preceding years for more individual instruction by which each student may advance as rapidly as his ability and industry will allow. Dean Raymond also contended for an all-year session in engineering schools in order that the students may have more time for the increasing demands upon them. He prefers this method of lengthening the course to the five-year plan advocated by many educators. Dean C. H. Benjamin, of Purdue University, and Prof. J. H. James, of the Carnegie Technical Schools, called attention in their papers to the rapidly growing importance of chemical engineering.

The colleges are meeting the demand for instruction in this line, but there is great diversity of practice. Prof. A. H. Blanchard, who is in charge of the new highway engineering courses of Columbia University, outlined the plan and scope of these courses. They are scheduled for the winter season when out-of-door work is impossible. The students will be able to take part in road construction during the summer and fall.

BUSINESS AND SOCIAL FEATURES.

Among the items of business taken up by the Pittsburgh meeting an important one was the decision to continue the publication of the monthly *Bulletin*, which has been issued tentatively for the past year. To permit this required the raising of the membership fee from $3.50 to $4 per year.

The officers elected at the meeting to serve one year are as follows: President, Dean W. G. Raymond, University of Iowa; vice-presidents, Dean G. C. Anthony, Tufts College, and Mr. F. B. Gilbreth, New York City; treasurer, Mr. W. O. Wiley, New York City; secretary, Prof. H. H. Norris, Cornell University. The members of the council elected to serve three years are as follows: Mr. J. E. Boyd, Ohio State University; Dean C. H. Crouch, University of North Dakota; Prof. F. L. Emory, West Virginia University; Prof. C. E. Magnusson, University of Washington; Prof. H. H. Stoek, University of Illinois; Prof. J. A. L. Waddell, Kansas City, Mo.; Prof. A. J. Wood, Pennsylvania State College. The reports of the treasurer and the secretary indicated a thriving condition of the society. The receipts were in excess of the expenditures and the membership increased more than a third during the year.

The social side of the meeting was well looked after by the local committee, comprising Deans C. B. Connelly, F. L. Bishop and J. H. Leete, Prof. W. E. Mott and Mr. C. F. Scott. Inspection trips, advertising and local entertainments were provided. A dinner at the Country Club, given by Director A. A. Hamerschlag and the faculty of the Carnegie Technical Schools, and a luncheon tendered by Chancellor S. B. McCormick and the faculty of the University of Pittsburgh were very enjoyable. While the serious business of the convention was in progress the ladies were entertained by automobile rides and other diversions. A unique feature was an informal reception at the Carnegie Institute, at which Pittsburgh alumni of the various colleges were invited to meet their former teachers. The foyer of the music hall of the Institute resounded with the unaccustomed sound of college yells.

Chicago Convention of American Institute of Electrical Engineers.

The twenty-eighth annual convention of the American Institute of Electrical Engineers in Chicago on June 26 to 30, 1911, was by far the most largely attended convention ever held by the society and probably the most successful also. The final registration was 930, including about 100 ladies. Of the total number about 530 were from Chicago or its suburbs, the remaining 400 being out-of-town members. This attendance is so far in excess of any previous Institute convention as to be remarkable. There were thirty-five papers presented at the session, and as a rule they were of a high order of merit. Parallel sessions were held on two days, and the whole affair was spirited and enthusiastic. Both President Jackson and President-elect Dunn were present, and the convention was the occasion of the resignation of Mr. Ralph W. Pope, the veteran secretary, who has held office since 1885. The entertainment features were lavish and carried out without a hitch, thanks to the local convention and entertainment committees, and there were numerous social gatherings "on the side," some of them very brilliant.

The opening reception of Monday evening, June 26, and the power-station session of Tuesday morning were reported by telegraph in the *Electrical World* last week. Herewith is given a general condensed account of the proceedings from that time, abstracts of papers and discussions appearing in another place in this issue.

CIRCULAR INSPECTION TOUR.

On Tuesday afternoon members and visitors, as guests of the Western Electric Company, were taken on board a special train to the Hawthorne plant of the company, where

President D. C. Jackson.

an appetizing luncheon was served in the large employees' dining-room. During the luncheon music was furnished by the Western Electric band. A short tour of inspection was made through the power house and the cable factory, after which the party reboarded the special train and was taken to the Fisk Street station of the Commonwealth Edison Company. Following an inspection of the great turbine and boiler rooms and the switch houses of this 120,000-kw generating station and its neighbor, the 84,000-kw Quarry Street station, the Institute delegation was conducted to a tent erected on the plant grounds, where refreshments were provided through the courtesy of the central-station company. Each member of the party received a souvenir

President-elect Gano Dunn.

booklet prepared especially for the Institute convention, and a number of the delegates returned downtown by a special boat chartered by the Commonwealth Edison Company.

ELECTRIC-LIGHTING SESSION.

Mr. H. M. Byllesby, of Chicago, opened the Tuesday evening electric-lighting session with his paper on "The Responsibilities of Electrical Engineers in Making Appraisals," in which he declared that to the capitalist, the promoter and the man who is able to influence capital, as

well as to the engineer, proper credit should be given for the accomplishment of these great results. Out of past and present controversies between corporations and the public, he said, a condition of justice, honesty and fair dealing must come.

Mr. Henry Floy, of New York, followed Mr. Byllesby, with an abstract of his paper entitled "Depreciation as Related to Electrical Properties." Mr. Floy urged more general agreement on the terms used in discussing the subject of depreciation, and recommended co-operation among engineers, manufacturers and service corporations for the intelligent collection and correlation of data on which to base estimates of depreciation.

The discussion of the general subject of depreciation was opened by Mr. Bion J. Arnold, of Chicago, who declared it to be his conviction that not only should the public pay to the public-service corporation the cost of the service rendered by it, plus a fair return on the investment, but also an additional amount in return for the early hazards and losses incurred in establishing the business. Mr. W. F. Wells, of Brooklyn, N. Y., said that where property, though not new, is in first-class operating condition, its value should not be depreciated for purposes of rate making. Mr. J. W. Lieb, Jr., of New York, pointed out that in the case of electrical apparatus obsolescence, due to advances in the art, may form as important a part of the loss of value as depreciation due to wear. Dr. S. S. Wheeler, of Ampere, N. J., proposed that all kinds of depreciation be unified as a simplification of the problem. Mr. Emil Leonarz, of Mexico City, Mexico, said that, while rates are often lowered, they are not raised when lines are extended to reach and develop new territory, at great expense to the corporation. Prof. A. H. Ford, of the University of Iowa, suggested that public-service commissions fix the upper and lower limits beyond which, above or below, the commission should take a hand in regulating rates for the benefit of the public or company.

RAILWAY SESSION.

Wednesday morning's session was devoted entirely to the presentation and discussion of railway papers and was a lively and interesting meeting. Mr. E. F. W. Alexanderson, of Schenectady, was called on first to present an abstract of his paper on "Induction Machines for Heavy Single-Phase Motor Service." Following this, Mr. B. F. Wood, of Altoona, Pa., abstracted his paper, entitled "Some Data from the Operation of the Electrified Portion of the West Jersey & Seashore Railroad." Then followed the exhaustive paper by Mr. W. S. Murray, of New Haven, bearing the title "Electrification Analyzed and Its Practical Application to Trunk-Line Roads, Inclusive of Freight and Passenger Operation." This last paper was first presented at the Toronto meeting of the Institute on April 7 last.

Mr. Murray did not attempt to summarize his long paper, but made a general statement in which he said, among other things, that electrical men must be honest with themselves and not talk one system of electrification exclusively. They should get together and possess a real sense of the necessity of standardization on general principles for the use of electricity on heavy trunk-line railroading, including terminal and suburban traffic. The problem of electrifying the yards is very important, and the speaker pointed out the advantages of overhead catenary construction with single-phase operation for this purpose. Mr. Murray's remarks related principally to the experiences of the New York, New Haven & Hartford Railroad with single-phase operation. The speaker said that the first electric freight locomotive on that road weighed 151 tons, but locomotives of greater power are now available weighing only 116 tons. The latter develop from 40,000 lb. to 50,000 lb. of tractive force. Within the next three months 350 miles of the track of the New Haven road will be electrified, of which 250 miles will be operated on the straight single-phase alternating-current system.

Before inviting discussion, President Jackson announced the appointment of a committee on resolutions, consisting of Messrs. D. B. Rushmore, of Schenectady; C. E. Magnusson, of Seattle, and A. S. Langsdorf, of St. Louis.

All three papers were discussed together. The first speaker was Mr. Frank J. Sprague, of New York, who championed the use of direct-current motors for railway operation in his usual animated and vigorous fashion. Others taking part in the discussion were Messrs. E. B. Katte, of New York; L. C. Fritch, of Chicago; J. L. Woodbridge, of Philadelphia; Prof. D. C. Jackson, of Boston; N. W. Storer, of Pittsburg; J. W. Lieb, Jr., of New York, and C. F. Scott, of Pittsburgh. Messrs. Alexanderson, Wood and Murray closed the discussion. Written discussions were submitted by Mr. Philip Dawson, of London, and Mr. W. N. Smith, of New York.

Practically all the gentlemen taking part in the discussion expressed a desire to see a "get-together" spirit on the part of electrical engineers in relation to an approved system of trunk-line electrification. However, the advocates of the direct-current motors and the alternating-current motors appeared to be as fully impressed with the merits of each system as ever. Mr. Fritch, speaking from the viewpoint of a steam railroad engineer, made an especially interesting contribution to the discussion, while Mr. Woodbridge advocated the use of the storage battery. Mr. Storer exhibited drawings of the new 116-ton single-phase freight locomotive to which Mr. Murray referred. Mr. Lieb pointed out the interest of the great electric-service companies in the subject.

ELECTRIC CLUB LUNCHEON.

A pleasant feature of the convention was the luncheon given to the Institute by the Electric Club of Chicago. This was held at the Hotel Sherman immediately following the morning session of Wednesday, and about 500 gentlemen participated, of whom about 150 were members of the club, the others being its guests. At the conclusion of the luncheon Mr. H. E. Niesz, president of the club, extended greetings to the Institute. President D. C. Jackson, of the Institute, returned thanks for that society and commented on the success of the convention and the exceptional attendance. Mr. Gano Dunn, of Ampere, N. J., president-elect of the Institute, in a short speech dwelt on the value of the personal element in conventions. Engineers have the quality of open-mindedness and Chicago is noted as a center of open-mindedness. Mr. Dunn gracefully connected these two facts in his speech.

INDUSTRIAL POWER SESSION.

The industrial power session of Wednesday afternoon was opened with a paper by Mr. Arthur C. Eastwood, of Cleveland, Ohio, on the subject of "Automatic Motor Control for Direct-Current Motors." Mr. Eastwood's paper described a solenoid-switch device having the characteristic by which it remains locked out during the initial rush of motor-starting current, finally closing and cutting out resistance after the running current has fallen to a normal value. This result is accomplished by providing duplicate magnetic return paths for the flux through the core, the more reluctant of which when excited at high flux densities provides a counter attraction which neutralizes the closing action of the core.

Mr. E. J. Murphy, of Schenectady, N. Y., next presented a description and lantern slides of a single-coil starting switch element employing the unequal reluctant path principle similar to that used in the device above mentioned, but arranged with a pivoted armature and roller contacts, which, said the speaker, minimize friction. In this device the normal flux-conducting path of low resistance is fitted with a closed copper band which prevents flux from building up rapidly through this path, when used with a motor the starting current of which rises at a comparatively slow rate.

Mr. L. L. Tatum, of Milwaukee, then read a paper on

"Limitations of Rheostat Control," in which he described the functional limitations inherent to the types of control, those due to characteristics of the rheostat material, and switching-device limitations applying to the method of adjusting the resistance. The paper included a discussion of the application of various types of control to motor-driven machines of special requirements, and closed with a discussion of contact limits as affecting the design and use of control apparatus. There was no discussion on Mr. Tatum's paper.

"The Control of High-Speed Electric Elevators" was the subject of a paper by Mr. T. E. Barnum, of Milwaukee. Two types of electric elevators were discussed—the worm-gear drive with moderate-speed motor and the gearless drive with special slow-speed motor. The application of these types to office-building requirements, with analysis of their control systems, bringing out the principal features of each, made up the text of the author's remarks, which were illustrated with a number of curve-drawing meter records of the power taken for the operation of the cars. Mr. Barnum's paper was discussed by Mr. S. N. Clarkson, of St. Louis, and Mr. F. J. Newman, of Chicago.

"Electrically Driven Rolling Mills" was the subject of a paper by Mr. Wilfred Sykes, of Pittsburgh, who described a system of reversing-roll operation through the means of a motor-generator set coupled to a flywheel for reducing shocks of demand. Mr. Sykes' paper discussed the relative manufacturing advantages of the reversing and non-reversing rolling mills, and discussed the control of roll motors by which it is possible to reverse the mill even more quickly than the material can be handled. The discussion of Mr. Sykes' paper, which turned chiefly upon matters of steel-mill practice, was taken part in by Mr. Carl A. Pauly, of Schenectady, and Mr. R. Tschentscher, of South Chicago, Ill.

TELEGRAPHY AND TELEPHONY.

Four papers were presented at the parallel session of Wednesday afternoon bearing on telegraphy and telephony. Mr. J. G. Wray, of Chicago, presided at this meeting and was accorded a vote of thanks at the conclusion of it. The first paper presented was an unusually interesting one by Major George O. Squier, U. S. A., on "Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires." Mr. S. G. McMeen, of Chicago, who presented the paper, commented on the extremely interesting nature of Major Squier's invention and on the attention it had attracted in the technical and lay press. Mr. McMeen also commented on the fact that the patent covering the Squier system of multiplex telephony and telegraphy has been dedicated by the inventor to the people of the United States.

Those taking part in the discussion were Dr. Frank B. Jewett, of New York, and Messrs. E. F. W. Alexanderson, of Schenectady, and J. B. Taylor, of Schenectady. Mr. McMeen closed the discussion. The gist of the discussion was that, while the invention is a most beautiful and interesting one, it is at present to be regarded more as a fascinating laboratory experiment than a commercial possibility. Mr. McMeen remarked, however, that the important feature of the paper is the hope it holds out for the development of such a system and also that when Prof. Alexander Graham Bell finished his first telephone it also was only a beautiful laboratory experiment.

The paper by Mr. F. F. Fowle, of Chicago, on "Telegraph Transmission" was presented in abstract by Mr. F. H. Reed, of Chicago. Messrs. Bancroft Gherardi, of New York, and Prof. G. D. Shepardson, of Minneapolis, discussed the paper briefly.

Mr. Bancroft Gherardi then presented an abstract of his own paper on "Commercial Loading of Telephone Circuits in the Bell System," Mr. E. H. Bangs, of Indianapolis, Dr. F. B. Jewett, of New York, Mr. E. H. Colpitts, of New York, Mr. E. B. Craft, of New York, Prof. G. D. Shepardson, of Minneapolis, Mr. Allard Smith, of Chicago, and Mr. J. G. Wray, of Chicago, discussed the paper, Mr. Gherardi closing. This paper and its discussion brought out many interesting facts about the loading of telephone circuits not widely known.

Mr. F. P. Valentine, of Boston, presented his paper on "Problems in Telephone Traffic Engineering." Those discussing this paper were Messrs. A. P. Allen, of Chicago, W. Lee Campbell, of Chicago, and Bancroft Gherardi, of New York. Mr. Valentine closed by saying that recent telephone studies have reduced many things thought to be variables to well-known quantities. This work is carried on with increasing intelligence and great advancement has been made in the last four or five years.

BOAT RIDE ON LAKE MICHIGAN.

Nearly 1000 persons, members of the Institute and their guests, enjoyed the boat ride of Wednesday evening on the excursion steamer *United States* along the Chicago water front. By a happy coincidence a brisk, cool north wind had imported a crystal-clear atmosphere from the head of Lake Michigan and the lights of the city stretching for miles along the shore were visible from the vessel's course several miles off the land. Refreshments were provided on board the boat and an orchestra furnished music for those who cared to dance on the broad lower deck.

TRANSMISSION-LINE OSCILLATION.

With Mr. Percy H. Thomas, chairman of the committee on high-tension transmission, presiding, the transmission session of Thursday morning was opened with Mr. G. Faccioli's paper on "Electric Line Oscillations," which was read by Dr. Steinmetz. The author's paper dealt with tests carried out last summer on the 100,000-volt lines of the Great Western Power Company, to obtain information on oscillations and rises of potential due to switching operations. Extensive oscillograph records were secured depicting the conditions existing in the circuits. Twenty-one oscillograph records were reproduced in the paper, showing the effects of various switching operations under different conditions, which were fully described by the author, and explained by Dr. Steinmetz with his characteristic clarity of expression. These records show extremely high frequencies, although an absence of high potentials, thus showing that switching phenomena give rise to frequency impulses against which protection is mainly called for. Mr. Faccioli's paper was discussed by Mr. M. H. Collbohm, of Madison, Wis., Mr. D. B. Rushmore, of Schenectady, N. Y., Mr. P. R. Thomas, of New York, and Dr. Steinmetz.

DIELECTRIC STRENGTH OF AIR.

Dr. J. B. Whitehead, of Baltimore, next read a paper on "The Dielectric Strength of Air," supplementing the results presented in an earlier paper on the subject of the conditions under which air breaks down in the neighborhood of clean, round wires subjected to high voltage. The investigations included a summary of facts bearing on the fundamental relations between diameter and surface intensities, and showed the influence of stranded conductors, of variations in air pressure and of frequency.

Mr. F. W. Peek, of Schenectady, N. Y., followed Dr. Whitehead with a paper on "The Law of Corona and the Dielectric Strength of Air," in which he discussed results obtained by extensive investigations on the laws of corona carried out at Schenectady under the direction of Dr. Steinmetz. Mr. Peek's paper presented an enormous mass of observational data, attesting the elaborate and complete scale of the work undertaken and carried out with the pracically unlimited facilities at the command of the investigators. The paper pointed out that loss of energy does not begin immediately the disruptive gradient is reached at the conductor surface, but only after the disruptive strength of air has been exceeded over an appreciable distance from the conductor. Due, however, to conductor surface inequality, some loss occurs at lower potentials below the disruptive critical voltage. Mr. Peck's paper further disclosed the relation borne by corona loss to frequency, excess

voltage, conductor diameter, conductor distance, air density, humidity, snow, wind, fog, rain, etc.

The discussion of the two preceding papers was opened by Dr. Steinmetz, who was followed by Mr. C. M. Davis, of Schenectady, A. B. Hendricks, of Pittsfield, C. F. Scott, of Pittsburgh, and the authors of the papers.

REPORTS ON TRANSMISSION SYSTEMS.

A summary of the general facts brought out by reports on several large transmission systems of 80,000 volts pressure and above was next presented by Chairman Thomas. The facts stated were in reply to inquiries sent out by the Institute and were responded to by J. P. Jollyman, on behalf of the transmission system of the Great Western Power Company, Mr. W. S. Lee, of the Southern Power Company, Mr. M. Hibgen, of the Great Falls Power Company, and Mr. P. T. Hanscom, of the Central Colorado Power Company. Mr. Thomas observed that the operation of these high-voltage systems is in general as satisfactory as those working at lower potentials. A number of the plants are working near the corona-loss limit, although they are not handicapped in operation at the present potential. The chairman referred particularly to the operation and design of the suspension-type insulator construction and the troubles to be apprehended from the mechanical motions of such suspended wires. Mr. M. H. Collbohm, of Madison, Mr. L. C. Nicholson, of Buffalo, Mr. Paul M. Lincoln, of Pittsburgh, and Mr. N. J. Neall, of Boston, in the discussion presented the benefits of their own experience with high-tension construction, operation and maintenance.

EXCURSION TO GARY STEEL MILLS.

Thursday afternoon was taken up with the excursion to the great works of the Indiana Steel Company at Gary, Ind., 25 miles southeast of Chicago. Through the courtesy of the General Electric Company a special train, stocked with refreshments, was provided for the Institute members. At Gary the 600 visitors went aboard an observation train and were taken about the plant property, visiting the new coke ovens, the power plants, ore unloaders, conveyors, blast furnaces, open hearths and the various mills. Owing to the size of the party no stops were made for inspection of the interiors of any of the buildings, but through the courtesy of the steel-corporation officials, invitations were tendered to the Institute members to visit the plant in small parties for a complete inspection of the processes of steel manufacture at this most modern installation.

CONFERENCE OF SECTION DELEGATES.

At 8:30 Thursday evening a conference of Institute officers and section delegates was held under the chairmanship of Mr. Paul M. Lincoln, of Pittsburgh, who in his opening speech discussed the welfare of the local sections of the Institute, inviting the suggestions of delegates in attendance as to how sections may best work in harmony with local societies.

Prof. George A. Hoadley, of Swarthmore, pointed out that it was the desire of the sections committee that there should be concentration instead of dissipation of energy in the section relations with local engineering societies. He then called upon Prof. A. S. Langsdorf, of St. Louis, who described how local rivalry between societies had been ended in that city by the organization of a joint committee drawn from the various societies. This committee planned a scheme of co-operation, making the Engineers' Club the chief factor, with the national society branches as subordinates. A joint council, said Professor Langsdorf, is in charge of meetings and programs at St. Louis, and the result of the plan has been to stimulate interest and attention at all of the meetings.

Mr. L. L. Tatum, of Milwaukee, said that the Institute section there is the tenant of the Milwaukee Engineers' Society, Institute section members receiving all services for $3 a year, which is less than the Engineers' Society members pay. The average attendance at meetings has been between forty and fifty. On account of the number of young engineers engaged with the large manufacturing companies at Milwaukee effort has been chiefly to bring out and stimulate the interest of these young men.

Mr. N. J. Neall, of Boston, said that in his city the chairman of the Institute section appoints a delegate to serve on a joint committee with those of the three other engineering societies. Three joint meetings are held a year, one under the auspices of each society. A social event of importance is the joint engineering dinner, the attendance of which has reached 400 persons. Mr. Neall pointed out the advantages of a common mailing bureau, equipped with addressograph, etc., for the several engineering societies.

Mr. Earl Wheeler, of Washington, D. C., said that the electrical men in the capital city expect to co-operate with the Washington Society of Engineers, possibly also holding combination meetings with the Baltimore Section of the Institute.

Mr. Ralph W. Pope, secretary of the Institute, said that beginning with the coming season he expects to devote all of his attention to section work, and hence is much interested in the development of section interest. He discussed the various plans of section organization and section dues and pointed out that a local engineering society often exerts more influence on the popular mind than a mere branch section of the national society. However, he urged members of the Institute to form a local section where possible. Mr. Pope also referred to the possibilities of forming sections at Birmingham, Ala., and in New York City. The New York Section, he explained, would permit the discussion of many interesting papers and subjects of a less important nature than it is now possible to bring up at regular meetings of the Institute. Mr. Pope also alluded to the useful service of social sessions and excursions to plants in bringing out many persons to section meetings.

Mr. E. Leonarz, of Mexico City, suggested co-operation between the headquarters of national societies and declared that in such case probably an engineering building might be obtained in Mexico City.

MR. POPE'S RESIGNATION.

President D. C. Jackson then addressed the meeting with relation to the general matters of the Institute, the main object of which, he said, is the stimulation of the engineering spirit among electrical men. The Institute now has nearly 7400 members, having taken on 436 during the last year, so that the present problem is not to increase the size of the organization, but to assimilate the existing new membership. President Jackson spoke of the national character of the trusteeship and members of the board, which, he pointed out, is made up of delegates from a number of states, although for purposes of obtaining a quorum a number of the board are necessarily chosen from New York City. The American Institute of Electrical Engineers, said President Jackson, is the only institution of similar importance in which no traveling expenses are paid officials for attending meetings. Nevertheless, he added, the organiza-

Secretary Ralph W. Pope.

tion enjoys the most conscientious and exacting attendance of those intrusted with its trusteesl ip.

The Institute, continued President Jackson, now has clear unencumbered property amounting to $600,000, the major part of which is a one-third interest in the Engineering Societies Building in New York. Ample funds are in the treasury to offset the existing mortgage against the land on which the building stands and which is owned by the Institute. Of the yearly income of $97,000 which the Institute enjoys, said the president, $65,000 is now required for printing proceedings, holding meetings, for office expenses and for other routine matters. The $35,000 remaining last year was divided into three parts—one going to meet expenses of the various committees, another being applied on the library fund and a third being divided among the several sections of the Institute.

President Jackson next referred with feeling to the loyal services of Secretary Ralph W. Pope, now closing his twenty-sixth year in the service of the organization, during which time upon him more than anyone else had devolved the work of building up the Institute to its present important position among engineering societies. The resignation of Mr. Pope as secretary was announced. President Jackson expressed his own regret that the effort to elect Mr. Pope honorary secretary with a vote on the board had been unsuccessful when presented to the membership, and declared that in affectionate recognition of Mr. Pope's notable services to the Institute the board intends to employ him as honorary secretary, with supervision of section affairs, at the present salary. A committee headed by Mr. Samuel G. McMeen recommended that the amendment relating to the secretary's election be resubmitted to the membership, proposing that on account of the long and faithful service of Mr. Pope he be apopinted honorary secretary for life, at the salary now received by him. A resolution of the section delegates read by Professor Langsdorf also placed on record the high personal esteem and regard in which Mr. Pope is held by the Institute members.

Secretary Pope expressed feelingly his appreciation of the sentiments expressed by the Institute's officers and members, and referred to the high standard of progressiveness which characterizes the American Institute of Electrical Engineers. He referred modestly but with evident pride to his own connection with the growth of the Institute, and said that he felt the best time for him to retire has now come with the Institute's attainment to a position of importance, housed in a great building adequate to its needs. Feeling the weight of advancing years he has tendered his resignation, to take place Aug. 1. This resignation has been regretfully accepted by the board of managers, who propose, however, to re-employ Mr. Pope as honorary secretary in charge of section affairs.

METHODS OF INSTITUTE ELECTIONS.

As the result of a motion introduced by Professor Langsdorf, chairman of the sub-committee on methods of electing Institute officers, an extended discussion occurred on the subject of official nominations and elections. Campaign methods were declared unethical, and objections were made to the board's right to choose its own successors by appointment. Methods were asked which would better recognize numbers and geographical distribution of voters.

President-elect Gano Dunn referred to the predominating interest which the presidential vote attracts over that for other members of the governing body of the Institute. The motion for territorial representation he compared to governmental conditions in this republic, where Senators are chosen by states and Representatives by districts, according to the population. Mr. Dunn also brought forward a method of election proposed by Assistant Secretary Hutchinson by which any nominee securing a petition signed by 50 or 100 members might announce his candidacy for an Institute office. The ballots giving this list of nominees could be accompanied by professional records of the candidates, to aid voters in making their selection. President-elect Dunn also announced the reappointment of Mr. Paul M. Lincoln as chairman of the section committee during the coming year, which provoked hearty applause from the members present.

GENERAL PAPERS OF FRIDAY.

Prof. George F. Sever, of New York, presided at the general session of Friday morning. Six papers were presented, the first being that of Mr. R. Wikander of Pittsburgh, whose subject was "Economical Design of Direct-Current Electromagnets." This was a mathematical treatment of electromagnet design with practical applications of the theory outlined. There was no discussion.

"Electrolytic Corrosion in Reinforced Concrete" was the title of a paper by Prof. C. E. Magnusson, of Seattle, and Mr. G. H. Smith. Professor Magnusson gave an abstract of the paper, which he spoke of as a progress report, showing the results of tests at the University of Washington. Various methods of preventing corrosion were discussed by the authors. Mr. Burton McCollum of the Bureau of Standards, Washington; Mr. E. W. Stevenson, of Wilkes-Barre, Pa.; Prof. George A. Hoadley, of Swarthmore, Pa.; Prof. A. S. Langsdorf, of St. Louis, and Prof. G. D. Shepardson, of Minneapolis, took part in a short general discussion, Professor Magnusson closing. The general opinion seemed to be that there should be no undue alarm over the danger of electrolytic corrosion from iron embedded in concrete. Written contributions to the discussion were received from Messrs. Harry Barker, of New York, and Prof. W. L. Upson, of Burlington, Vt., jointly, and from Mr. Guy F. Shaffer, of New York, and Mr. Maximilian Toch.

Mr. H. Weichsel, of St. Louis, abstracted his paper on "Wave Shape of Currents in an Individual Rotor Conductor of a Single-Phase Induction Motor." Mr. Theodore Hoock, of Wilkinsburg, Pa., discussed the paper briefly and Dr. A. S. McAllister sent in a written communication in which he protested against giving credit incorrectly for developing the method described by Mr. Weichsel in his paper as originally prepared. Chairman Sever asked Mr. Weichsel to consider this point, and the author of the paper said that Dr. McAllister was right and that he wished to correct the error, and indeed had already done so.

A similar paper was that on "The Choice of Rotor Diameter and Performance of Polyphase Induction Motors," written and presented by Mr. Theodore Hoock, of Wilkinsburg, Pa. Messrs. E. F. W. Alexanderson, of Schenectady, C. J. Fechheimer, of Ampere, N. J., and H. Weichsel, of St. Louis, discussed the paper, Mr. Hoock closing.

Mr. J. R. Craighead, of Schenectady, abstracted his paper on "The Aplication of Current Transformers in Three-Phase Circuits." Then Mr. R. W. Atkinson, of Pittsburgh, presented the paper on "The Cost of Transformer Losses" prepared by Mr. E. C. Stone, of Pittsburgh, and himself. These papers were discused at the same time. Mr. A. H. Pikler, of Ampere, N. J., praised the Stone and Atkinson paper. Mr. W. C. Smith, of Pittsfield, Mass., Mr. E. A. Wagner, of Ft. Wayne, Ind., and Mr. H. B. Gear, of Chicago, also took part in the discusssion.

Mr. R. W. Pope, whose resignation as secretary, to take effect on Aug. 1, was announced at a preceding session, spoke briefly, praising those who had made the preparations for the convention, and particularly Mr. George F. Sever, chairman of the committee on meetings and papers.

RESOLUTIONS.

At both of the Friday morning sessions the committee on resolutions, consisting of Messrs. Rushmore, Magnusson and Langsdorf, presented its report, which was adopted without dissent. Thanks were extended to Mr. L. A. Ferguson, chairman, and the members of the convention committee; to Mr. H. M. Byllesby, chairman, and the members

of the entertainment committee; to the Electric Club of Chicago; to the ladies of Chicago, and to the commercial organizations extending courtesies. The report contained this interesting declaration: "The extraordinary success of the Chicago convention, the greatest in the history of the Institute, redounds to the credit of those responsible for its arrangement and attests the suitability of the great metropolis as a convention city."

MECHANICAL CHARACTERISTICS OF TRANSMISSION LINES.

With Mr. D. B. Rushmore, of Schenectady, in the chair, the high-tension transmission meeting of Friday morning (parallel session) opened with a paper on "The Solution of Problems in Sags and Spans," by Mr. W. L. R. Robertson, of Philadelphia. In the paper the author discussed the application of the catenary, rather than the parabola, to the solution of spans of great length and large sag, in which the latter quadratic curve is less accurate than for short spans of small sag. Mr. Robertson's paper discussed the effect of change in temperature and tension on the sag of the span, and presented calculated results and actual measurements of characteristic spans under varying summer and winter conditions. The paper concluded with a discussion of spans supported from different levels, with definitions of sag under these conditions.

"The Mechanical and Electrical Characteristics of Transmission Lines," a paper by Dr. Harold Pender and H. F. Thomson, was read by Mr. Thomson. This paper presented in compact form data and formulas, together with their derivations, required for determining the mechanical and electric characteristics of transmission systems. A set of charts appended with the paper enables various mathematical operations to be accomplished graphically with minimum effort. The authors first discussed the mechanical analysis of spans of various kinds, the second part of the paper being made up of mathematical analyses of the electrical characteristics of transmission systems.

Mr. P. H. Thomas next illustrated graphical methods of making sag calculations for suspended wires, with the aid of curves plotted to show stresses as ordinates and lengths and sags as abscissas. Included in Mr. Thomas' paper were examples of practical calculations using this method, originated by him, together with the theoretical derivation of the curves.

The three preceding papers on transmission-line subjects were discussed by Messrs. D. B. Rushmore, of Schenectady, Paul M. Lincoln, of Pittsburgh, L. C. Nicholson, of Buffalo, N. J. Neall, J. B. Balcomb, of Chicago, W. E. Belcher, of Chicago, and P. H. Thomas, of New York.

Mr. A. O. Austin, of Barberton, Ohio, next read a paper on "The High-Efficiency Suspension Insulator," in which he described tests of this important new piece of transmission apparatus under conditions simulating those of actual operation. The studies included flash-over or arcing tests, and the author exhibited curves showing the surface resistance of the insulators. The paper was chiefly taken up with a study of dielectric, flashing and puncture tests, and closed with an account of the mechanical strength of these insulators. Mr. Austin's paper was discussed by Messrs. E. E. F. Creighton, of Schenectady, Paul M. Lincoln, of Pittsburgh, L. I. Thomas, of Chicago, and N. J. Neall, of Boston.

UNIVERSITY ORGANIZATION.

Prof. A. S. Langsdorf, of St. Louis, presided at the concluding session on Friday afternoon, at which only one paper was presented, that of Mr. Ralph D. Mershon, of New York, entitled "Tentative Scheme of Organization and Administration of a State University." In the absence of the author, Prof. John H. Hunt, of Ohio State University, Columbus, Ohio, read the paper. Prof. A. H. Ford, University of Iowa, Iowa City, opened the discussion, and he was followed by Prof. C. F. Harding, Purdue University, Lafayette, Ind.; Prof. B. B. Brackitt, State College, Brookings, S. D.; Prof. A. S. Langsdorf, Washington University, St. Louis; Prof. G. D. Shepardson, University of Minnesota, Minneapolis, and Prof. M. C. Beebe, University of Wisconsin, Madison. The general trend of opinion appeared to be unfavorable to the proposal outlined by Mr. Mershon, particularly in respect to the plan of having an alumni advisory board associated in the control of university affairs.

In a few closing words Secretary Pope alluded to the size and success of the convention and explained that President Jackson had to leave before the last day in order to catch a steamer to Europe, as he had received an urgent call to England on consultation work on which he is engaged.

Vice-president Paul M. Lincoln, of Pittsburgh, then took the chair and declared the twenty-eighth convention adjourned.

CONVENTION NOTES.

Mr. Louis A. Ferguson gave an enjoyable luncheon to his fellow past-presidents of the Institute at the South Shore Country Club on Thursday at which problems of society development were discussed. The party included Messrs. T. C. Martin, Frank J. Sprague, F. B. Crocker, C. P. Steinmetz, B. J. Arnold, J. W. Lieb, Jr, S. S. Wheeler, D. C. Jackson, Gano Dunn and the host.

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There were several college reunions during the convention, including luncheons for the Boston "Tech" men at Vogelsang's Restaurant on Thursday and for the University of Wisconsin engineering alumni at the Grand Pacific on Friday.

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Following the example of the New York N. E. L. A. convention placards were displayed at each session during parallel sessions showing what paper was being discussed at the other. Calls to the telephone or other messages were displayed silently by stereopticon without interrupting the proceedings.

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President Jackson was forced to leave for the East on Thursday evening. Messrs. Percy H. Thomas, Paul M. Lincoln, D. B. Rushmore, J. G. Wray, George F. Sever and A. S. Langsdorf made acceptable presiding officers in his absence and at parallel sessions.

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The convention arrangements in the hotel were excellent, but owing to the very large attendance it was sometimes difficult to make one's way about in corridors and lobbies.

The daily list of arrivals prepared under the direction of Assistant Secretary Hutchinson was helpful and accurate.

Thanks are due many Chicago members for placing their automobiles at the disposal of delegates.

* * *

Mr. Henry M. Byllesby took advantage of the convention to give an elegantly appointed dinner to about sixty gentlemen at the Chicago Club on Thursday evening, June 29. The table decorations and lighting effects were unique and beautiful. The large table was shaped like an hour-glass with ponds, goldfish, ferns and flowers at each end. A miniature electric railway encircled the ponds, while overhead a miniature aeroplane moved above the guests. There was a miniature "wireless" sending station and many other ingenious novelties. After an invocation by Rev. Dr. Page there were speeches by Mr. Byllesby, Mr. C. G. Dawes, president of the Central Trust Company of Illinois; Prof. D. C. Jackson, of Boston, president of the institute; Mr. George M. Reynolds, president of the Continental and Commercial National Bank; Mr. Samuel Insull, president of the Commonwealth Edison Company; Mr. Gano Dunn of Ampere, N. J., president-elect of the Institute, and Mr. B. J. Arnold, of Chicago. Among the other guests were Messrs. Reginald Belfield, of London; Horace G. Burt, of Chicago; D. B. Rushmore, of Schenectady; E. G. Cowdery, of Chicago; Prof. F. B. Crocker, of New York; Mr. L. A. Ferguson, of

Chicago; Mr. J. B. Forgan, of Chicago; Mr. A. S. Huey, of Chicago; Mr. H. H. Kohlsaat, of Chicago; Mr. T. C. Martin, of New York; Mr. E. W. Rice, Jr., of Schenectady; Mr. Charles F. Scott, of Pittsburgh; Mr. Frank J. Sprague, of New York; Mr. M. B. Starring, of Chicago; Mr. B. E. Sunny, of Chicago; Mr. Hugh M. Wilson, of New York, and Mr. S. S. Wheeler, of Ampere, N. J.

The speeches were in earnest vein, following the example set by the host, and related to the economic and industrial condition of the country. The dinner served also to enable a number of visiting engineers to become acquainted with some of the leading men of affairs of Chicago.

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About fifty members of the Tau Beta Pi fraternity among the delegates to the convention held an informal dinner in the Gray Room of the Hotel Sherman Wednesday evening, June 28. Among the members of the fraternity present at the meeting were President Dugald C. Jackson, of the institute; President-elect Gano Dunn; Past-presidents Charles P. Steinmetz, Bion J. Arnold and John W. Lieb, Jr., and Messrs. P. Junkersfeld, R. F. Schuchardt, W. L. Abbott, A. N. Motter, J. R. Bibbins, Elwood Grissinger, Prof. W. F. M. Goss, of the University of Illinois; Prof. C. F. Harding, of Purdue University; Prof. George D. Shepardson, of the University of Minnesota; Prof. H. V. Carpenter, of Washington State College, and Prof. P. B. Woodworth, of Lewis Institue, Chicago. The dinner was arranged by Mr. Ralph H. Rice, of the board of supervising engineers, Chicago Traction.

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A reception and tour through the galleries of the Chicago Art Institute was arranged for the visiting ladies of the convention on Wednesday afternoon. Following the reception the party was divided into groups, under the direction of persons connected with the Art Institute, who conducted the ladies through the galleries, explaining objects of interest. A 5 o'clock tea followed the gallery tour.

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The ladies of the convention were entertained at luncheon at the South Shore Country Club on Thursday. Automobiles left the Hotel Sherman at 11 a. m., taking the ladies out to the club over the South Park boulevards. An orchestra was provided at the club for the occasion, and during the luncheon Venetian gondoliers dressed in native costume strolled through the dining-room singing boat songs. A handsome menu formed the souvenir of the luncheon. Returning, the party was taken in automobiles for a trip through the West Park system, reaching the Hotel Sherman about 6 p. m. Sixty-five ladies attended the luncheon and reception.

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Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers since 1885, presented his resignation to President Jackson at the convention, as noted elsewhere. Mr. Pope has been a conspicuous figure in the upbuilding of the great national engineering society with which he is connected and in doing so has become very widely known to the electrical engineers of the country. For some time, however, he has been planning to transfer his burden to the shoulders of younger men, and there has been considerable discussion of the manner in which the step should be taken. Mr. Pope's resignation is to take effect Aug. 1, when he will be made honorary secretary, receiving the same salary as at present and will have charge of section affairs under the general direction of the sections committee and the future secretary. By this plan the institute still has the benefit of Mr. Pope's counsel and services while expressing in a substantial way a realization of the value of the work which he has done for the Institute, and, indeed, for the whole industry. Mr. Pope was elected secretary of the Institute on May 19, 1885, succeeding Mr. T. Commerford Martin, who had been appointed acting secretary to fill the vacancy caused by the resignation of Dr. Nathaniel S. Keith, the founder of the American Institute of Electrical Engineers, and its first secretary. Mr. Pope was at that time associate editor of the *Electrician and Electrical Engineer*. During the following two years it became evident that the growth of the electrical industry required that the secretary should devote practically his entire time to the affairs of the Institute and plans to this end went into effect in 1888. Concurrently the first independent office of the Institute was established at 5 Beekman Street. Perhaps the most important improvement introduced at this time was the organization of monthly meetings which appeared necessary in order to keep abreast of a rapidly growing art. This was followed by the publication of the *Proceedings* monthly, and the issuance of an annual volume. In 1893 the establishment of sections was suggested and the entire plan was outlined in a paper presented by Mr. Pope at a meeting of the Institute Oct. 18, 1893. Local meetings were held in Chicago in 1894, the first being fixed for March 21. This was of unusual interest for the reason that it was simultaneous with the New York meeting, and connection by telephone was established between them through the courtesy of Mr. Edwin J. Hall. The question of local meetings languished, however, until 1902, when, under the administration of President Scott, it became a well-recognized development of the policy of the Institute. Mr. Pope's previous experience in journalism, telegraphy and railroad accounting was of great value when devoted to requirements of the secretary's office. He believed that the affairs of the Institute should be conducted on business principles, and this has been an important factor in its numerical growth and financial standing. A committee has been appointed to consider the selection of a temporary secretary.

The St. Louis Public Service Situation.

In a speech made at a dinner given in his honor by the St. Louis Section of the National Electric Light Association on June 24 Mr. Alten S. Miller, retiring president of the Union Electric Light & Power Company, of St. Louis, took occasion to allude to the relations of that company to the city government. He referred to the organization of the company as highly efficient, but said that the stockholders were not receiving a fair return on their investment, owing to the concessions demanded by the Public Service Commission of the city, and also, perhaps, to the policy of a board of directors in having too much confidence in public fairness and gratitude. As reported in the newspapers, Mr. Miller continued:

"The situation is a strange one. The Municipal Assembly has passed an ordinance under authority of a statute which gives power only to fix rates. The ordinance does not fix rates, but regulates the rates and operation of the company. Most of the regulations are reasonable and have been followed by the company for years. The company is willing to make a rate for residences that will average lower than 9½ cents per kw-hour, this rate to be arranged in such a maner as to stimulate business. The company went so far as to have an ordinance prepared that would give the city practically all it asked for, but when this ordinance was presented to the company's counsel he advised that it was subject to the same legal objection as the Municipal Assembly ordinance in that it regulated rates, whereas the city has only the right to fix rates. In the words of 'Pooh Bah,' 'Here's a pretty mess.' As a result of a series of blunders the city has passed an act which we are told by counsel, and believe, cannot be enforced."

In concluding Mr. Milller gave his former associates in the company this advice: "If you do not believe in the honesty and good intentions of the management, you should go elsewhere. You can accomplish little without confidence in your employers and associates. If you are convinced, you must shout it from the housetops. Tell

your neighbors and friends and their friends that the company is fair and reasonable; that it has spent millions and is entitled to a fair return on the money so spent; that it is entitled to some consideration for its good service to the public and to some share of the saving made through economical management. In time the people will realize that you are right."

Street Lighting and Franchise Controversy at Chisholm, Minn.

A pending lawsuit at Chisholm, Minn., in regard to a franchise and street-lighting contract has recently been settled by the passage of a new franchise ordinance for the electric-light and power company. This controversy arose primarily out of alleged failure of the Range Power Company to give adequate electric-light and motor service. The village of Chisholm is a rapidly growing town of about 5000 population in the heart of the famous Mesaba iron-mining district, and is near to several large iron mines. In 1908 the town was practically destroyed by forest fires, and soon after the Range Power Company was given a twenty-seven-year franchise. The company was operating a gas engine and producer previous to the burning of the town with but poor success. After the fire the company continued to operate with gas engines and producers by adding apparatus, but the results remained unsatisfactory. Interruptions to service were frequent and voltage fluctuations and low voltage were common, even during the time the plant was in operation. To make matters worse, the town and the company's business grew so rapidly as to overload the plant, in spite of the poor service, as a rapidly growing mining town demands electric-light service even if it is not of the best. Protests were made by city officials and by mass meetings of citizens against the kind of service which was being rendered, but the company seemed unable to cope with the situation. Frequent serious breakages of gas-engine parts occurred and the overhauling of the machinery seemed only to be followed by further accidents and interruptions.

After two years of poor service the village board cast about to see what relief could be obtained and the company's ordinance as drawn seemed to offer some opportunity for action by the city. This ordinance provided for all-night service except in certain contingencies, such as fire, riot, etc., when the company might be excused temporarily. It also provided that the street arc lamps should be of 1200 cp each (nothing being said as to this being a nominal rating) and that the city had the privilege of hiring an expert to test the candle-power, and if the lamps were found to be less than 1200 cp the expense of the test was to be paid by the company and no money paid by the city for the service. The ordinance also provided that poles and wires be maintained in safe condition. In September, 1910, to conform with the ordinance, the city employed Mr. J. R. Cravath, of Chicago, as expert to conduct a test of the candle-power of street lamps and a forty-day test on the general character of the service rendered, both for street and commercial-lighting purposes. This test covered the candle-power of street arc lamps, interruptions to street-lighting service, street lamps out and in bad order, interruptions to commercial incandescent electric-lighting service, voltage regulation of incandescent service and safety of the company's pole lines and other devices.

In the report of this test, which was rendered to the village board in November, it was first pointed out that actual 1200 cp is a commercial impossibility with the 4-amp magnetite series-arc lamps used. Manufacturers' tests in printed matter showing a maximum of less than 700 cp and National Electric Light Association street-lighting committee reports rating such lamps at 480 cp were quoted. It was shown that to comply with the terms of the ordinance a 6.6-amp magnetite arc should have been installed. Tests made on the lamps in actual service at Chisholm showed poor maintenance conditions. These showed candle-powers at the most favorable angle of from 516 maximum to 84 minimum. A number of lamps were found to be giving very low candle-power, which was presumably due to electrode troubles or dirty globes, as voltage measurements on the dim lamps showed voltages from 65 to 70, as in the case of the best lamps.

As regards the 1200 cp named in the franchise contract, it was pointed out that there was no excuse for ignorance on this subject by those engaged in the electric-light and motor business in 1908, when it was drawn. For several years previous to that time there had been extensive discussion of the old, erroneous readings of arc lamps, both in the conventions of the National Electric Light Association and in the technical press. The tests showed that the current and voltage supplied to the lamps were slightly in excess of that at which the lamps were rated. During the forty days of the test the street-lighting service was off 149 hours, owing to the inability of the station to carry the load during the early evening hours. Records of individual lamps out while arc service was on showed a large number of lamps in bad order.

Interruptions to incandescent-lighting service in the forty days' test totaled twenty-six hours and fifteen minutes during ordinary lighting hours. Voltmeter readings taken by means of recording voltmeters located at different points and by means of a portable voltmeter at a considerable number of points each day showed voltages ranging from 112 to 50, voltages between 80 and 90 being very common on some dates. The report also called attention to the fact that the company's secondary circuits were not grounded as recommended by the American Institute of Electrical Engineers and the National Electric Light Association; that as a precaution for public safety this should be done and that the city should require it and insist on connection being made to the city water mains.

After receiving the engineer's report the village board, acting under legal advice, declared forfeited the street-lighting contract of the company because of lack of fulfilment of its conditions, and also declared void the company's franchise ordinance for lack of fulfillment. Proceedings were immediately begun by the city to bring suit in order to get an order of court confirming these actions by the City Council. The company's representatives admitted the inadequacy of the service which had been rendered, but maintained that the interruptions had been due to causes beyond the company's control. In the fall of 1910 it installed a steam engine of 400 hp with two 150-hp boilers. With the aid of this steam apparatus it was able to give considerably better service. In the hope that municipal purchase and operation would afford relief from the intolerable service the city employed Mr. Charles L. Pillsbury, of Minneapolis, as consulting engineer to make an appraisal of the company's property. Mr. Pillsbury reported a valuation approximately equal to the bonds on the property, and the city offered the company a sum considerably in excess of the appraised valuation. The officers of the company refused this offer.

At the last moment before the case was to be tried an agreement was reached whereby the company received a new ordinance which had been passed by the Council and goes into effect upon acceptance by all of the bondholders. This ordinance gives the company a twenty-five-year franchise and a contract to supply 4-amp magnetite, constant-current luminous-arc lamps, taking 60 volts to 70 volts at the lamp. It is elsewhere specified that these lamps shall give approximately 480 cp from 10 deg. to 15 deg. below the horizontal when in street use. They are to be maintained in service 3650 hours a year. The price is to be $120 per year per lamp. The maximum rate for commercial lighting service is to be 11 cents, with discounts for quantities, instead of 14 cents as before. A minimum service charge of

50 cents per month is allowed. For motors a minimum charge of 50 cents per horse-power per month is provided. Provision is made for revision of the company's rates at certain periods throughout the life of the ordinance, such revision being made by arbitrators appointed in the usual way, one arbitrator by each party and the third by the two so chosen. Provision also is made for purchase by the village of the company's plant at certain stated periods upon notice being served by the city. In such an event the valuation is to be made by arbitrators on the basis of the cost of reproduction of the plant less proper depreciation. The purchase price is to be 10 per cent more than the valuation. The earning capacity, goodwill and franchise are not to be considered in determining the valuation.

From the standpoint of the city this ordinance is an improvement over the old one because of the relief it affords from inadequate service by purchase of the plant by the city. From the standpoint of the company it is an improvement because it does not require arc-lamp candle-powers of impossible realization with the apparatus now installed. The maximum rates are 11 cents per kw-hour in the new ordinance as against 14 cents in the old. The city officials of Chisholm were apparently actuated by no particular desire to have municipal ownership of the plant, but simply by a desire to get adequate service. The whole trouble seems to have arisen from an overestimate on the part of the company of the ability of some of the older types of gas engines and producers to give reliable service. While the experience of the Chisholm company with a gas-producer plant has been disheartening, it should be remembered that gas-engine and producer plants are being successfully operated in numerous cases over the country, and that failure in this case is to be attributed to the particular unfortunate conditions existing in this plant rather than to gas-engine producer plants in general, including failure to recognize that the successful operation of a plant of this kind calls for men skilled in gas-engine and producer operation.

Massachusetts Legislative Notes.

The bill providing for the electrification of steam railroads at Boston subject to the supervision of the Railroad Commission has been referred to the next Legislature by the Senate, the vote being 19 to 13 against the passage of a law requiring electrification by the present Legislature. This action destroys any hope of an electrified suburban service based upon a compulsory act in 1911. There is still some prospect that a bill authorizing the New York, New Haven & Hartford Railroad to build a tunnel under Boston Harbor will be passed at this session, and if this is done, a provision for electrification between Readville and Lynn is regarded as practically certain. With the approval of Chairman Hall, of the Railroad Commission, a bill has been introduced giving mandatory instead of recommendatory powers to the commission, including the power to originate investigations of rates and service.

Massachusetts Commission News.

The Buzzards Bay Electric Company has petitioned the Gas & Electric Light Commission for authority to extend its lines into the towns of Bourne, Barnstable and Sandwich. The Fall River Electric Light Commission has petitioned the commission for the right to issue $200,000 of additional stock, to meet the cost of plant extensions and improvements.

Two new petitions bearing upon the question of rates have been received by the Gas & Electric Light Commission, one coming from consumers of the Natick Gas Light Company's service and requesting a reduction in the price of gas, and the other from residents of Revere, praying for a reduction in the price of electricity.

New Jersey Commission News.

The New Jersey Board of Public Utility Commissioners has recently approved an ordinance of the borough of Penns Grove granting franchises to the People's Rural Telephone Company and has also approved the proposed issue by the West Jersey & Seashore Railroad Company of 5 per cent mortgage bonds to the amount of $1,089,000.

A hearing has been held by the board on the complaint of Cochran, Drugan & Company, manufacturers, whose works are located across the line dividing Hamilton Township from the city of Trenton. The Trenton & Mercer County Traction Company charges a 10-cent fare to this point, which the complainant alleges is more than is charged for greater distances in other directions by the same company, and places it at a disadvantage in the employment of labor. The company contended that the terms of its franchises do not admit of its collecting more than one fare in Hamilton Township, and that if it extended the 5-cent fare zone beyond the boundary line it would be unable to collect an additional fare for a trip of several miles through the township.

New York Commission News.

The New York Public Service Commission, Second District, has received a petition from the Olean Electric Light & Power Company for an order authorizing the issue of $185,000 first-mortgage 5 per cent forty-year gold bonds. The proceeds are to be used for the construction and equipment of a new generating station at Sears and the building of a high-tension transmission line from Sears to the city of Olean and making improvements to its present distributing system in the city of Olean, for an additional distributing line to the city of Allegany, acquiring and installing a new arc-lighting system in the city of Olean, and for the refunding of present mortgage indebtedness.

The village of Hunter, Greene County, has petitioned the commission for an adjustment of certain difficulties that have arisen between it and the Schoharie Light & Power Company because of the expiration on Nov. 1, 1910, of a five-year contract for street lighting which was held by the Schoharie company. The village alleges that it has elected to exercise the right to renew this contract for a further term of five years at the same price, but that the company refuses to accept the renewal and desires an increased rate. Negotiations for a new contract having finally failed, the company shut off the supply of service and the commission is now asked by the village authorities to adjust the matter. The price paid under the old contract was $15 a year for thirty-four incandescent lamps of 32 cp each, the contract further providing that the company should install and maintain without cost to the village one 2000-cp inclosed-arc lamp. As a further cause of complaint against the company the trustees allege that in violation of the conditions of the franchise under which the company operates, the company arbitrarily refused to change the location of several poles in accordance with the request of the municipal authorities. A copy of the complaint has been served upon the company with the direction that answer be made within five days provided the street-lighting service is not at once renewed. In case the company is willing to renew the street-lighting service it may have twenty days in which to make answer.

Maryland Commission News.

The Maryland Public Service Commission has received an application from the Baltimore & Washington Transit Company for permission to reorganize and issue second mortgage 5 per cent bonds to the amount of $50,000, as it

has been unable to redeem the December interest coupons on its outstanding $100,000 bond issue and is in need of more money with which to extend and complete its system. It is understood that those interested in the project have agreed to subscribe to the new bond issue which the commission is asked to authorize.

The Baltimore city administration filed with the commission its complaints against the rates charged by the Consolidated Gas, Electric Light & Power Company for gas and electricity. City Solicitor Edgar Allan Poe submitted both complaints to Mayor Preston and the latter promptly approved them. They were at once filed with the Public Service Commission. Messrs. Charles M. Cohn, general manager of the gas division of the company, and Herbert A. Wagner, general manager of the electric division, acting under the direction of President J. E. Aldred, of the company, held a long conference with the members of the commission relative to the procedure to be adopted by the company in filing its answer to the complaints. The commissioners were assured by these gentlemen that the company was both willing and anxious to have the question as to rates threshed out before that body, and, speaking for the company and Mr. Aldred, Messrs. Cohn and Wagner informed the commission that every assistance would be given the commission in the examination of the company's books and property.

The price of electricity, especially to small consumers, will be investigated by the Public Service Commission. The company charges small consumers 10 cents a kw-hour, which the petitioners declare is unjust and unreasonable. The matters to be examined by the commission, as stated in their resolutions adopted last week, are: First, whether the prices charged by the Consolidated Gas, Electric Light & Power Company for electricity are unjust and unreasonable. Second, whether such charges are unjustly discriminatory or unduly preferential. Third, whether the commission should determine the reasonable charges to be hereafter in force as the maximum for the service.

The Jubilee of the Dynamo.

BY BROTHER POTAMIAN.

Among approaching celebrations is one to be held in Pisa in honor of the fiftieth anniversary of the construction of the first commercial-type dynamo by Dr. Antonio Pacinotti in 1861. In 1860, while a student under his father at the University of Pisa, the young inventor, then in his nineteenth year, had the matter of a direct-current machine well in mind. He had a clear apprehension of the principles and mechanism by which such currents could be generated and utilized. He did not, however, rush into print, but rather delayed public announcement of the work upon which he was engaged until he had settled all details and constructed a model that realized his expectations. Three years later, in 1864, he wrote a full account of his invention and published it in the columns of the *Nuovo Cimento*, together with an illustration of the little machine itself.

Pacinotti's invention attracted very little attention at the time; indeed, it was not until 1881 that the originality and merits of the invention were publicly recognized, and then by the award of a diploma of honor at the Paris Exposition of that year.

In his experimental machine Pacinotti used for the first time the ring armature with its symmetrically grouped coils connected to the bars of the commutator, an arrangement that was reinvented by Gramme and embodied by him in the dynamo which he gave to the industrial world in 1870.

Pacinotti seems to have resembled Faraday in his preference for the field of research rather than for the field of development and exploitation. Having discovered the commutated-ring armature and satisfied himself of its usefulness as a generator of direct currents, he left to the ingenuity of others the task of converting his laboratory model into a thoroughly practical and commercially efficient machine.

The principle of reversibility did not escape the attention of the young Pisan investigator, for he says in equivalent words that by supplying the machine with current it will work satisfactorily as a motor.

The reversibility of the Gramme machine was first shown by Fontaine at the Vienna Exposition of 1873, where the writer saw two similar Gramme machines connected electrically together and placed some 1600 ft. apart. The generator was driven by a gas engine; on closing circuit the distant machine was set in motion and used in the operation of a pump.

Many years later the writer saw another instance of the principle of reversibility. In this case it was the reversibility of the electrostatic machine, of the Winshurst type, shown by the inventor himself at his home on Clapham Common, London. The generator was a 12-in. machine; the motor, which was about 4 in. in diameter, responded

Antonio Pacinotti.

very well to the energy which was sent through its brushes, and even made its usually calm and phlegmatic inventor wax enthusiastic, for the nonce, over its excellent performance.

The early recognition by Pacinotti of the great principle which renders the electrical transmission of energy possible places him among the pioneers of science and the benefactors of humanity. He is now in his seventy-first year (born June 17, 1841), professor of technological physics in the University of Pisa and Senator of the Kingdom of Italy.

Interesting matter connected with this first chapter in the history of the modern dynamo will be found in the library of the American Institute of Electrical Engineers. No. 1601 of the catalog of the Wheeler gift contains the six pages of the original article, with illustrations, published in the *Nuovo Cimento* in 1864 under the title of "Descrizione di una Macchinetta Elettro-Magnetica." No. 2444 consists of an autograph letter and memoranda, sketches and photographs (of father and son) furnished by Pacinotti to the late Mr. Franklin L. Pope to assist in the preparation of an article from his gifted pen which, under the title "The Genesis of the Modern Dynamo: Antonio Pacinotti," appeared in the *Electrical Engineer* in September and October, 1892.

CURRENT NEWS AND NOTES.

ELECTRICAL ENGINEERING AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Besides graduating the largest class ever passing from the undergraduate course, the Massachusetts Institute of Technology conferred one degree of doctor of engineering and four degrees of master of science on men taking graduate work in electrical engineering. The applicants for permission to become candidates for advanced degrees in electrical engineering are already more numerous than they were last year, and particularly is this true in respect to graduate students who intend to study the problems of electric railroads, electric transmission of power and the organization and management of public-service companies.

Grounding in Denver.—The Denver Gas & Electric Company now has all its secondaries grounded, utilizing the water mains entirely. Its distributing system is also grounded to a city hydrant on each block, and its regulations require that all new interior installations shall have the neutral and the conduit grounded to the largest available water pipe within the building.

* * *

Boston Edison Service Adopted by Carlisle.—The Edison Electric Illuminating Company of Boston has entered into a ten-year street-lighting contract with the town of Carlisle, Mass., which lies in the outer suburban area at the west of Lexington and Bedford. The town has a population of about 600, a street length of about 37 miles and an area of 16.1 sq. miles. About 4.2 miles of streets will be covered by Edison lighting and power service in the initial installations. The most remote point in the town is about 23.5 miles from the company's generating station in South Boston. It is expected that electricity will be applied extensively in this community for both agricultural and domestic service.

* * *

Electric-Vehicle Investigations.—The electrical engineering department of the Massachusetts Institute of Technology has received an appropriation of $3,000 from the Edison Electric Illuminating Company of Boston to be used in an investigation of the relative operating reliability and cost of electric trucks, gasoline trucks and horse trucking, for the purpose of determining to what degree electric trucks are adapted to compete with gas and horse trucks in the city of Boston. This investigation will cover the cost of delivery of goods in the different ways and comprise all questions which concern electric trucks, including the influence of the different kinds of city pavements on cost of delivering goods and the effects of different routings of the vehicles. The investigation will be partly theoretical, but it will be planned to determine practically what it ordinarily costs to deliver goods under city conditions. This part of the investigation will be accompanied by actual observations extended over a period of many months. At least a year will be occupied in this work and Mr. H. F. Thomson has been appointed research associate to carry on the work under the direction of Professor Pender.

* * *

Novel Electrical Party at Fall River, Mass.—A party of officers and employees of the Fall River (Mass.) Electric Light Company, with their wives, was recently given a novel entertainment at the home of Mr. and Mrs. F. S. Root. Invitations were issued to "A Shocking Affair," the cards being decorated by drawings of streaks of lightning. Upon arriving at the house the guests were subjected to a number of so-called shocks, arranged as follows: Shock No. 1 consisted of cartoons of those in attendance thrown upon the screen by means of an electrically illuminated post-card projector. The second shock consisted of the identification of various groups of objects representing some electrical term, the word "in-can-descent" being prepared by a bottle of perfume in a tin can; the word transformers being represented by boxes of cold cream, rouge, puffs, etc., and the word tungstens being indicated by ten shoe tongues. In the third event the guests performed various "stunts," including a game of ring toss in which an incandescent lamp was lighted whenever the ring was successfully thrown over two miniature lighting poles. Another incident was the playing of a game similar to "pit" in which the word "electricity" was used in place of the usual cards. Score cards were in the form of incandescent lamps. Refreshments were served at a table decorated with a model of the company's main generating station, including a pole line wired with miniature lamps with colored bulbs. From the lighted station came the hum of a small motor, and smoke produced by smoldering cotton issued from the chimney in a lifelike fashion. Current was supplied from a dining-room chandelier, the realistic wires being concealed by the smoke from the chimney. The affair was unanimously voted a great success by the participants. The host is in charge of the power sales department of the company.

* * *

Illuminating Engineering Society Convention in Chicago.—The date of the forthcoming convention of the Illuminating Engineering Society to be held in Chicago has been fixed for Sept. 25, 26 and 27. Mr. John F. Gilchrist, of the Commonwealth Edison Company, 120 West Adams Street, is serving as chairman of the convention committee.

* * *

Engineering Degrees at University of Illinois.—The College of Engineering of the University of Illinois at the commencement exercises on June 14 conferred the bachelor's degree in engineering upon 202 men, the master's degree upon nine men and the professional degrees of civil engineer, mechanical engineer and electrical engineer upon eight, four and five men respectively.

* * *

St. Louis N. E. L. A. Section.—At a meeting of the St. Louis Section of the National Electric Light Association (Union Electric Light & Power Company) held on June 24 officers for the ensuing year were elected as follows: President, Mr. B. F. Crouch; first vice-president, Mr. E. H. Tenney; second vice-president, Mr. Orrin Hull; secretary, Mr. H. G. Kislingbury; treasurer, Mr. D. A. Scullin.

* * *

Over 9000 N. E. L. A. Members.—The successful administration of Mr. W. W. Freeman as president of the National Electric Light Association came to a close June 30 with a total of no less than 9214 members. He began his term with a total of 5736, which shows a gain of 3478 for the twelve months. This is, of course, unprecedented in the annals of engineering bodies, but it is believed that the coming year under President Gilchrist may see the figures matched, as there is a strong movement on foot in all parts of the country toward the formation of company sections and the affiliation of state associations. There are indications that the membership during the coming year will easily reach not less than 12,000.

* * *

Anniversary Booklet of Boston Edison Company.—In connection with the twenty-fifth anniversary of the organization of the Edison Electric Illuminating Company of Boston, Mass., an attractive booklet of forty-three pages has been published, reviewing the history of central-station development in Boston during the quarter century that has elapsed since the inauguration of service from the original station near Head Place. The booklet describes the salient events which have occurred during the growth of the company from these small beginnings to a system embracing 600 miles of territory, a population of about 1,000,000 and over 1300 employees. The first station contained a 90-hp engine belted to two Edison dynamos capable of supplying 500 incandescent lamps, while to-day the company has a generating capacity of about 70,000 kw, with maximum units under construction or in contemplation of about 14,000 kw. Nearly forty municipalities are supplied with the company's service. The booklet contains numerous illustrations of the company's generating plants and substations, a map of the initial and present systems, chronology of important events in its life, and a valuable table of capitalization, earnings, expenses, dividends, sales of stock, customers, connected load segregations, rates and electrical sales by years for the entire period of 1886 to 1910.

A BRITISH DISTRICT-SUPPLY SYSTEM.

Dunston Generating Station of the Newcastle-Upon-Tyne Electric Supply Company.

THE Northeast Coast Power System now covers an area of over 1000 square miles, extending from Blyth in the north to Guisboro in the south, and westward from the coast to Consett and Bankfoot, England. At the present time it is supplying some 150,000 hp of plant, in connection with railways, tramways, collieries, shipyards, lighting, heating, cooking and chemical works.

Its principal generating station is at Carville-on-Tyne, which is coal-fired, while it generates a large quantity of energy at stations utilizing waste heat from coke ovens, blowing engines, etc. The principal of these are at Blaydon, Newport, Weardale, Bankfoot and Bowden Close. Others are in process of construction at Redcar, Port Clarence and elsewhere. The steady growth in the company's business has entailed the erection of an additional coal-fired station which has been recently built at Dunston-on-the-Tyne and is here described.

Fig. 1—Dunston Station of the Newcastle-Upon-Tyne Electric Supply Company.

The Dunston power station of the Newcastle-upon-Tyne Electric Supply Company—one of the largest and most recently designed power stations in Europe—contains several novel features. Its construction was decided upon by the company about three years ago in order to provide for the continued increase in business, amounting to about 20,000 hp per annum. Although the company has still more spare land at Carville, it was considered by the engineers to be better to put the next instalment of generating plant higher up the Tyne. A site of about thirty and one-half acres was obtained on the south bank of the Tyne at Dunston, about 3 miles above the High Level Bridge and some 8 miles from Carville. One reason for this course was to obtain in the neighborhood of the station plenty of land for further new processes which are being attracted to the district as a result of the cheap electrical energy. The company is already supplying large electrochemical works near Carville, but the land available for future developments near Carville is not large, whereas at Dunston there is at present plenty of land available for future requirements. Another reason for this policy is that it has resulted in practically doubling the cable capacity of the very heavy cable network which exists on both sides of the Tyne. The Dunston station is situated near one end of the Tyne network and the Carville station is situated toward the other end. The cables are connected together at Carville by means of a tunnel constructed under the river and again higher up the river over the King Edward Bridge and the old High Level Bridge. It will therefore be seen that the erection of the Dunston station improves the position of the company not only from the point of view of generating-station capacity but also to a most important extent from a distribution point of view also.

As the Northeastern Railway has bridges over the Tyne both at Blaydon and at Newcastle, the Dunston power station being about equally situated between the two, coal supplies can be obtained with almost equal facility from either the Durham or the Northumberland coal fields. Condensing water is obtained from the River Tyne by means of suction pipes for each generating unit taken direct to the river.

GENERAL DESIGN.

The station generates three-phase currents at a frequency of forty cycles and a normal potential of 5750 volts. The steam pressure is 200 lb. and the steam is superheated, the total temperature being practically 570 deg. Fahr.

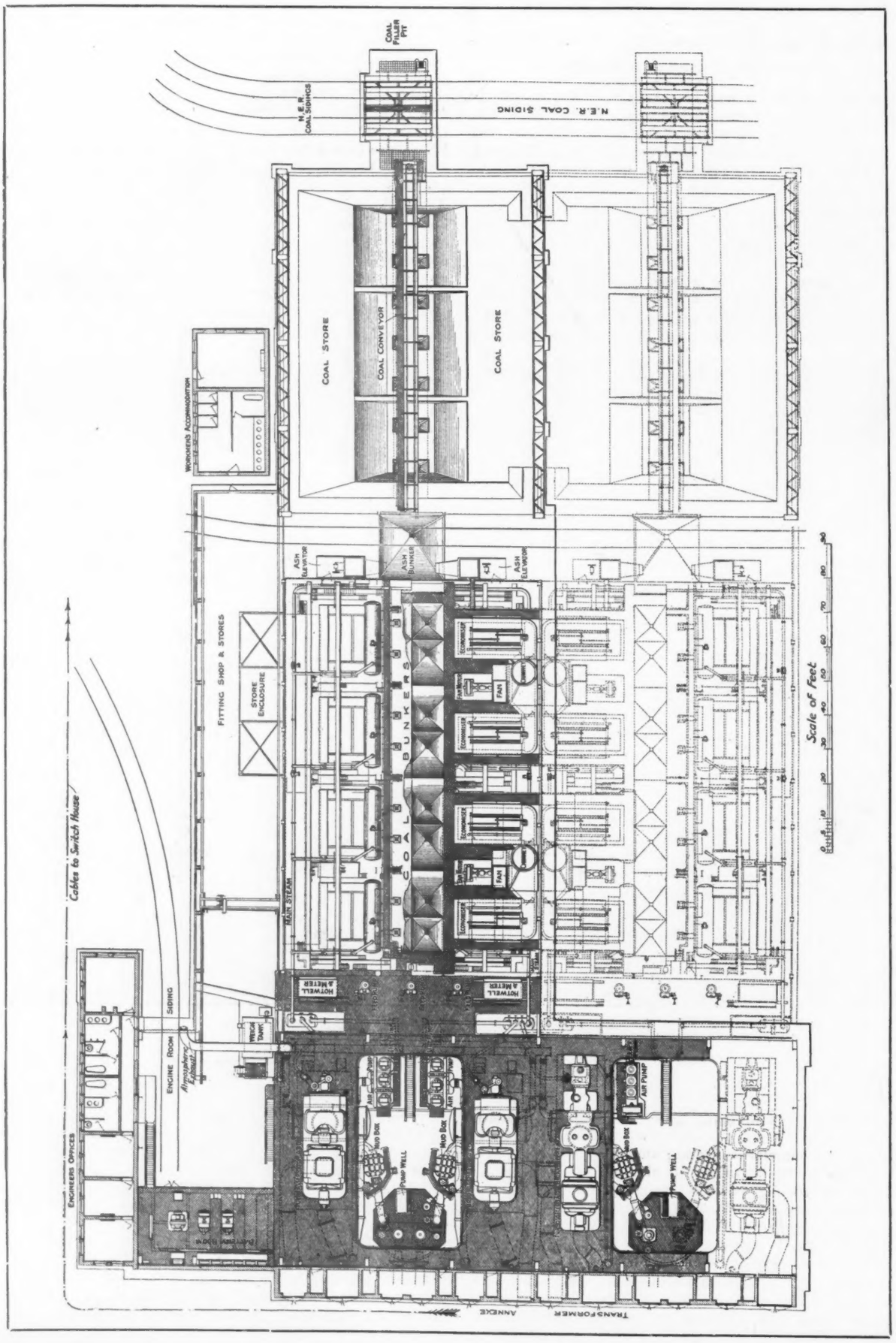


Fig. 2—Plan of Dunston Station of the Newcastle-Upon-Tyne Electric Supply Company.

The station is designed to accommodate eventually six generating units, each of 8000 kw normal rating and 10,000 kw maximum rating. If further extensions are necessary it is intended to commence a new engine-room. The engine-room has so far been built for four units, of which there are already three installed.

For every two units there will be a boiler house, or three

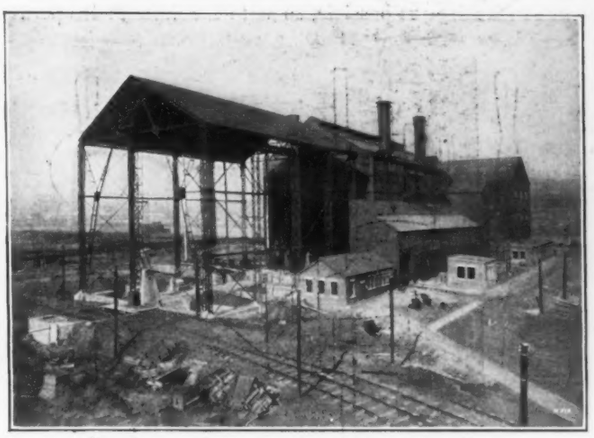


Fig. 3—General View of Station.

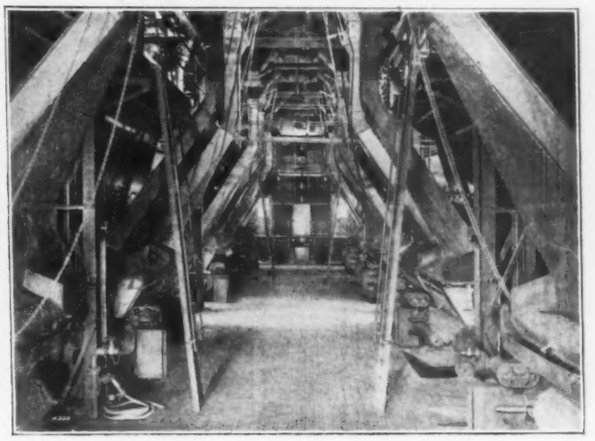


Fig. 5—Boiler-Room of Dunston Station.

boiler houses in all. One has so far been completed. On each side of the boiler house there are four boilers, three of which are capable of supplying steam to drive one generating unit at full load, or eight boilers per house, so that eventually there will be twenty-four boilers in the station.

THE BOILER HOUSE.

The general arrangement of the boiler house consists of a basement 18.5 ft. high in which the ashes are dealt with. Ash bunkers are provided under each boiler capable of storing the accumulation of ashes from fourteen hours' working at full load. This means that at ordinary load-factors each ash bunker need be cleared only once in every twenty-four hours. The ashes are removed by trucks which are hoisted by electric elevators and dump their load into an overhead ash bunker. This ash bunker has a capacity equivalent to from two to three days' working of the boiler house and is arranged over a railway siding so that ashes may be either taken away by rail or taken by railway trucks to the dock and dumped into barges.

The boilers are grouped together in pairs on the first floor, each boiler having its own superheater and economizer, but the gases from each pair of boilers are dealt with by one separately driven 65-hp fan and one chimney, both placed immediately over the corresponding boilers. Between the economizers, which are arranged overhead in pairs, and down the center of the boiler house are bunkers capable of holding a week's supply of coal, assuming the station to be operated at 50 per cent load-factor. The whole boiler installation is designed so that when working at maximum economy the chimney gases are reduced in temperature to below 300 deg. Fahr.

The coal, which is delivered to the receiving hoppers by bottom-dumping cars, passes first through a crusher and is then lifted by means of a Babcock & Wilcox conveyor capable of dealing with 40 tons of coal an hour. Advantage has been taken of the necessity for a conveyor to provide at the end of the boiler house storage for three weeks' supply of coal in addition to that in the bunkers over the boilers themselves. The inclosure is arranged to receive coal from the conveyor which feeds the boiler-house bunkers. Underneath the hoppers there is a tunnel for feeding the same conveyor, so that the one conveyor delivers coal direct to the boiler-house bunkers or delivers it to the storage bins or takes it from the latter to the boiler-house bunkers. The coal from the overhead bunkers is led by vertical gravity chutes direct to the receiving hoppers, whence it is fed into the boilers by Babcock & Wilcox chain-grate stokers, the grate area per boiler being 168 sq. ft. The economizers, of which there is one to each boiler, are

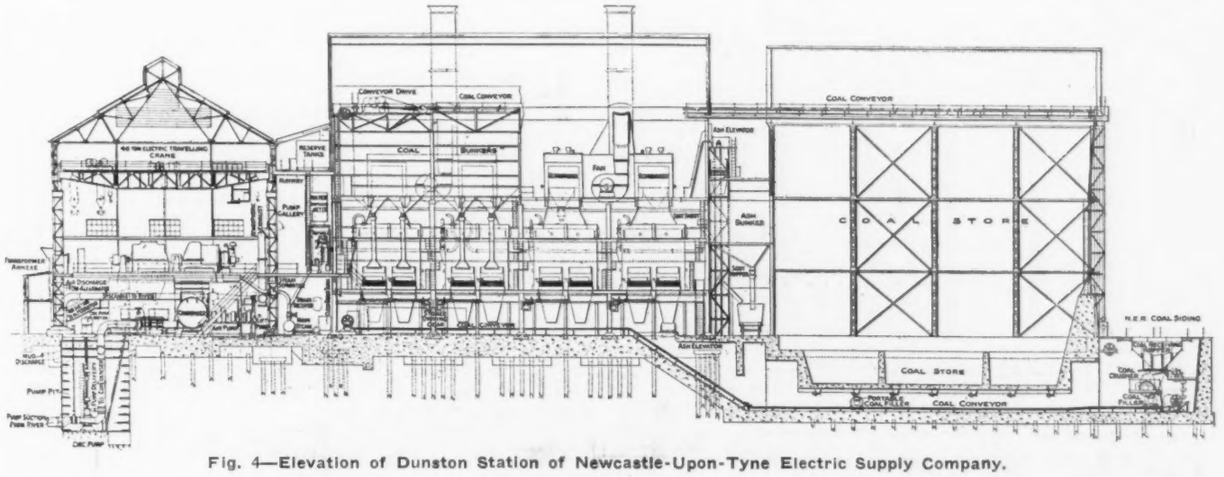


Fig. 4—Elevation of Dunston Station of Newcastle-Upon-Tyne Electric Supply Company.

situated at the top of the building, where the fans are also placed in a well-lighted and roomy economizer house.

The boiler house has a series of galleries at different heights for water tenders and in order to give access to the economizers, fan motors, etc. Each mechanical stoker and each economizer scraper is driven by a separate inclosed electric motor.

GENERAL ARRANGEMENT OF BUILDINGS.

The design provides that eventually there shall be three end-on boiler houses, each with its own coal storage on the land side of the engine-room. The buildings are all steel frame structures, very little brickwork being used at all. All the main switchgear is arranged in a separate building about 450 ft. away from the engine house, thus allowing not only of a very light and convenient engine-room but of a switchhouse from which cables can be taken in and out on any side, thereby greatly facilitating future extensions.

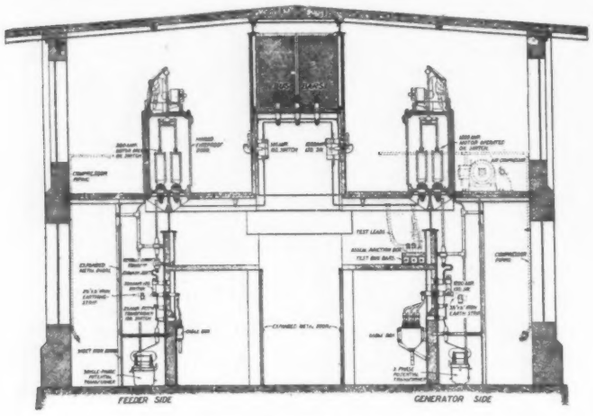


Fig. 6—Section Through Switch House.

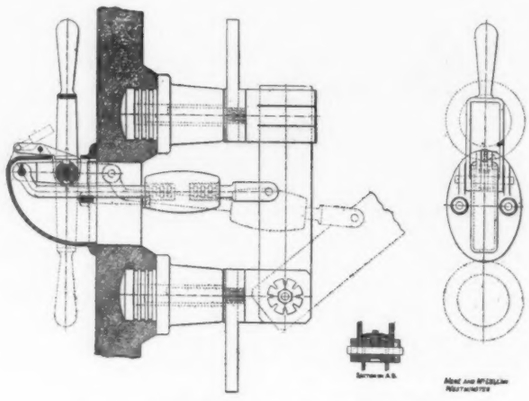


Fig. 8—Operating Gear of Isolating Switch.

ARRANGEMENT OF UNITS.

There is one coal-storage, boiler-house and coal-handling plant for each set of eight boilers, and one boiler house to each turbo-alternator unit. There is one main steam pipe, feed-water pipe, hot-well pump and ash-conveying plant for each set of four boilers. There is one economizer and coal chute for each boiler. Each turbo-alternator unit has its own set of engine-room and boiler-house auxiliaries, supplied with energy from an independent "unit" transformer.

TURBINE-ROOM.

The existing turbine-room, which has been built to accommodate four turbines, has a railway siding under a 40-ton overhead crane. Adjacent to the siding is a space at the ground-floor level which can be used for the accommodation of the different parts of a turbo-alternator during repairs or overhaul. This space communicates by means of a smaller overhead crane with the fitting and repair shop erected parallel to the first boiler house. Adjacent to this shop are offices, messroom and lavatories for the mechanical engineers in charge of the station and the engine-room staff.

The designers have aimed to get as compact an arrangement of machines as possible, so as to facilitate their operation, but at the same time to have everything, including auxiliary machinery, accessible to the overhead crane. This even applies to the circulating-water sumps, of which there will eventually be three, one for every two units. These circulating-water sumps are situated in the engine-room, midway between each pair of turbines, and go down a depth of 30 ft. below the engine-room floor level. In each circulating-water sump there are two main centrifugal pumps, one for each generating unit, and situated at such a depth that they are under water at all stages of the tide. The pumps have vertical spindles and are driven by 60-hp, three-phase electric motors installed on engine-room floor level. The suction of each circulating pump communicates by a 24-in. cast-iron pipe direct with the intake sumps at the river. The intake sumps are provided with gratings, and additional self-cleaning screens are provided for each condenser. One salt-water pump is also installed in each sump for supplying water for general cleaning purposes.

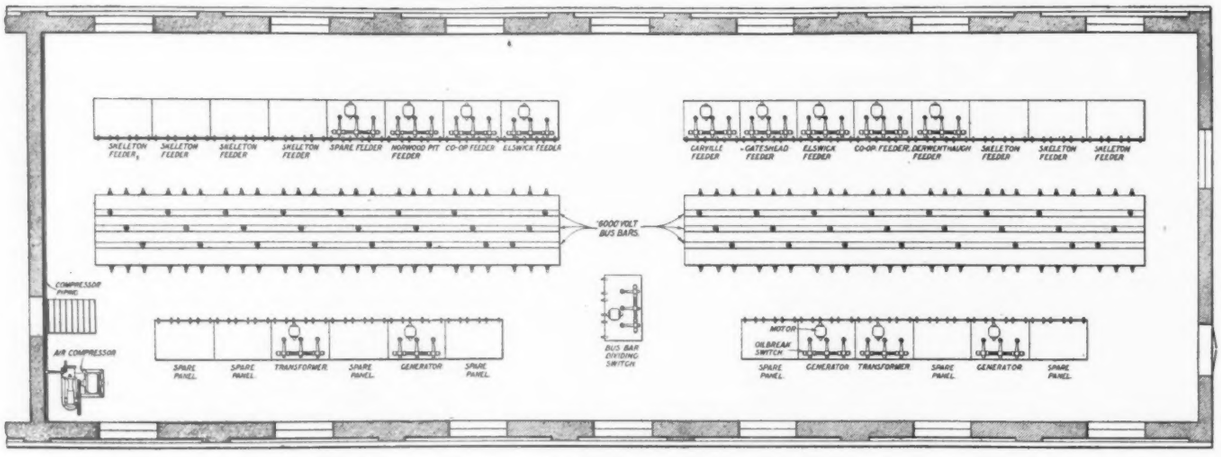


Fig. 7—Plan of High-Tension Switch Room.

Contrary to Continental practice, at Dunston the necessary access to the turbines is secured by means of openwork cast-iron floor plates and galleries. The whole appearance of the engine-room, provided as it is with both a monitor

roof and large windows running the whole length of the north side, is light in the extreme. Behind the turbines on the same level and between them and the boiler house are the feed pumps, hot wells, water meters, etc., these being arranged to be operated by the turbine attendants. Be-

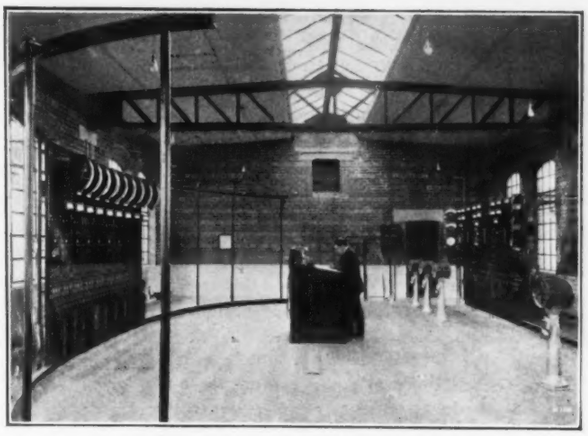


Fig. 9—Control-Room in Switch House.

neath the pump gallery are various smaller pumps, etc.; on the same basement level are the condensers and electrically driven air pumps. The feed-pump exhausts can be taken either to the hot-well tanks or to the water softener, or passed direct to the atmosphere.

TURBO-ALTERNATORS.

Two of the turbine sets at present installed are of the Allgemeine Elektricitäts Gesellschaft impulse type, and one is of the Parsons-Richardson-Westgarth-Brown-Boveri type. The alternators are designed to stand the severest short-circuits which are likely to come upon them in practice. The exciters are arranged on the ends of the alternator shafts. The ventilating fans are on the alternators themselves, and the air is drawn in through special filters, there being a separate duct and filter for each alternator. The outlet air ducts from the alternator are so arranged that the hot air can either be discharged outside the building or into the engine-room, thus making it possible to control the temperature of the engine-room at will.

AUXILIARIES AND STATION SUPPLY.

Three-phase current is used at 440 volts throughout the station for motive power. The motor-driven auxiliaries belonging to each unit are normally fed from a separate 500-kw "unit" step-down transformer installed in a fireproof compartment opposite each alternator. The primary of the transformer is directly connected, through switches, to the main terminals of its own alternator so that the auxiliaries are supplied even if the main alternator switch be off. In addition to these separate low-tension three-phase circuits, for each unit, there is a common low-tension three-phase system fed from the main high-tension busbars in the switch house through two 500-kw, three-phase transformers, which supply a set of busbars placed in an inclosed gallery in the engine-room. A supply can be given for starting up from these busbars to the auxiliaries belonging to each unit. The fields of the exciters can be separately excited. Two 50-kw motor-generators provide a supply of direct current at 100 volts for lighting the station and for charging the station battery, which is kept in circuit to insure an absolutely independent supply of lighting. A smaller motor-generator is also used for charging two control batteries used for operating the high-tension switch gear. There are three batteries in all, the larger for lighting, giving 1000 amp for one hour, the two smaller 100 amp each. A 250-kw rotary converter supplies the energy for the electric locomotives.

SWITCH GEAR.

The switch-gear arrangements at Dunston are perhaps the most interesting part of the station, showing, as they do, a distinct advance upon previous practice. Instead of the usual elaborate switchboard, which forms a striking feature of most power-house engine-rooms, the Dunston engine-room contain practically no high-tension switch gear or electrical instruments at all. With the exception of certain unobtrusive high-tension panels of "Ironclad" type controlling the "unit" transformers which supply the auxiliaries belonging to each generating unit, and an indicating wall ammeter for each generator, the high-tension gear and instruments are installed in a separate switch house 450 ft. away from the engine-room.

There is, however, in the engine-room near each generator a set of emergency gear for tripping the main high-tension generator switches in the switch house, with which is interlocked a field switch. Apart from these and the direct-current gear for motor-generators, there are practically no electrical connections or cables visible at all; ducts, etc., for the whole of the main cable wiring having been provided for in advance and so hidden.

SWITCH HOUSE.

The switch house is a building with a concrete roof 135 ft. long and 33 ft. broad by 32 ft. high. It has two floors and is divided into two divisions. The front of the building contains on the ground floor the offices, lavatories, etc., for the control-room engineer. The operating boards are on the first floor. The back part of the building, shut off by iron doors, is devoted to the switch gear itself, the main oil-break switches and busbars being on the upper floor, while the isolating switches, series and shunt transformers, etc., are on the underside of the lower room, in full view and accessible from the lower room with ladders, but absolutely out of reach of accidental contact.

CONTROL-ROOM.

The control-room is a well-lighted apartment, 40 ft. by 30 ft., with part glass roof. It is mainly occupied by the semi-circular operating switchboard (for feeders) and the smaller board for generators. The operating board of black slate is divided into sections, the generator and transformer

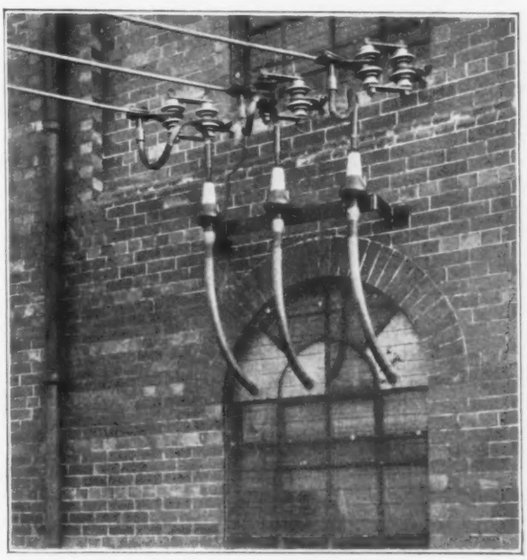


Fig. 10—Three-Phase Feeder Circuit.

panels and busbar switches being placed separately from those controlling the feeders. With a view to simplicity and facility for extensions the various operating panels are arranged so that it is possible at any time to change the particular feeder controlled by any individual operating

panel. The control gear is operated by means of direct current at a pressure of 100 volts from two small batteries specially used for this purpose.

GENERATOR AND FEEDER PANELS.

Each generator panel has a main ammeter and voltmeter, power-factor indicator, indicating wattmeter, field ammeter, watt-hour meter, etc. It also has a switch for controlling the governor of the turbine and a rheostat handwheel in front as well as a telegraph to each generator. At each end of the generator board is a synchronizing panel with a rotary synchronoscope. Each feeder panel on the feeder control board has a separate set of instruments and a set of synchronizing and voltmeter plugs for synchronizing any other generating station with the machines at Dunston. The feeders are protected with Merz-Price protective gear. Both the feeder and generating panels have throw-over control switches arranged to make or break the main oil-break switch immediately contact is made. The position of the main oil-break switch is indicated by the lighting of a red or blue lamp, and the operation last performed is automatically indicated by a small colored pin on the switch handle.

SWITCH-ROOM.

The switch-room itself has two floors. Access is obtained to the upper floor through an iron door leading from the control-room and to the lower floor from the passageway under the control-room. The busbars and main oil-break switches are on the upper floor and the connections and isolating switches and instrument transformers on the lower floor. The cables from separate generators or feeders are brought up through the ground into separate brick cells opening on to the central passageway in the lower chamber by an expanded-metal door. From the three-way dividing boxes the three single connections pass through the wall to a brick cell on the other side, which is accessible, by means of expanded-metal doors, from the outer passages running the length of the lower chamber. Each of these latter cells contains three single-pole main isolating switches as well as isolating switches for the shunt transformers which are placed on the ground below in a small brick cell, protected by sheet-iron doors. From the main isolating switches the three connections are taken up through expansion joints and series transformers to the bottom connections of the main oil-break switch in the ceiling, the switch itself being placed on the upper floor.

On the upper floor three molded stone slabs run parallel to each other along the room, being continuous except for a division of some 6 ft. or 7 ft. in the middle. The main 6000-volt busbars rest upon insulators on the central slab, which is 5 ft. high, and are protected by expanded-metal screens running up to the ceiling, thus forming a cage in which the busbars are placed and are visible for their whole length. The busbars are divided in the middle of the room by means of a main oil-break switch, capable of carrying 20,000 kw continuously. On the two side slabs are fixed the oil-break switches, the left side of the room being entirely devoted to feeders.

The main oil-break switches are of the British Thomson-Houston Company's type. The motors operating the switches are arranged to wind up a spring immediately the switch has operated, so that the make or break is instantaneous on the closing of the control switch. Each oil-break switch can be made "dead" by means of isolating switches, there being one set for isolating it from the busbar and one for isolating it from the incoming cables. The busbar isolating switches are situated under the busbar slab in the ceiling of the lower chamber, but the handles operating them are in the upper chamber on the side of the busbar slab, each one being opposite its own main switch. All the high-tension panels are provided with balanced protective gear.

In addition to the switch gear already described, there are in the engine-room a neutral isolating switch for each generator and a set of emergency tripping gear, by which the main generator oil-break switch in the switch house can be operated from the engine-room. On the wall of the engine-room opposite each generator there is an indicating ammeter and each generator also has its own "unit" transforming set in the transformer annex.

The direct-current switch gear principally consists of a 500-volt traction board and a 100-volt board, as well as the main lighting distribution fuse board. The main direct-current switchboard with the motor-generators is situated in the corner of the engine-room.

A NOVEL METHOD FOR MAGNETIZING TELEPHONE GENERATORS.

By H. P. Clausen.

As indicated by the title, this article is a discussion of a novel method for efficiently magnetizing the steel polarizing magnets of a hand-driven, two-pole-armature electric generator. Preliminary to this, however, a brief discussion appears advisable covering the characteristics of the current delivered by such a machine.

In building a generator suitable for use in connection with telephone apparatus it is the standard practice to construct the machine so that the armature will be rotated,

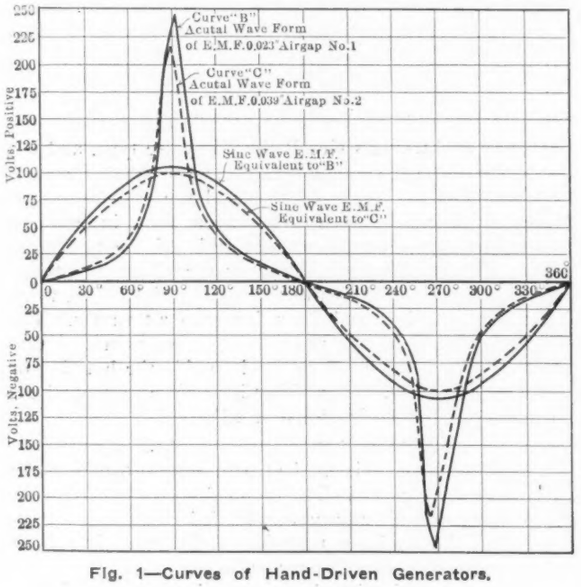


Fig. 1—Curves of Hand-Driven Generators.

approximately, five times for every revolution of the driving gear. Therefore, the average operator of the hand generator causes the armature to rotate so that current will be produced at about 20 cycles per second.

In order to secure a proper signaling margin it has been found necessary so to wind the armature that, with any system of permanent magnets applied, the current will be delivered at somewhere around 80 volts. Therefore, in the building of a hand-driven generator, it may be assumed that, with the armature rotating at the rate of 1000 r.p.m. and a voltmeter load of 1500 ohms, the current is delivered at about 80 volts.

In order to permit a study of the characteristics of an alternating current delivered by a hand-driven generator it will be of interest to note Fig. 1. This diagram shows the current produced by two generators exactly similar in so far as magnetic strength and windings are concerned, with the only difference that curve *B* shows the emf wave-form of a generator having an air space of 0.023 in. between the armature and the pole piece, while curve *C*

shows the form of wave when the same generator is provided with an air-gap of 0.039 in., the former curve being produced by machine No. 1 and the latter curve by machine No. 2.

In reducing the results of the direct measurement of the emf of the No. 1 and No. 2 machines it was found that

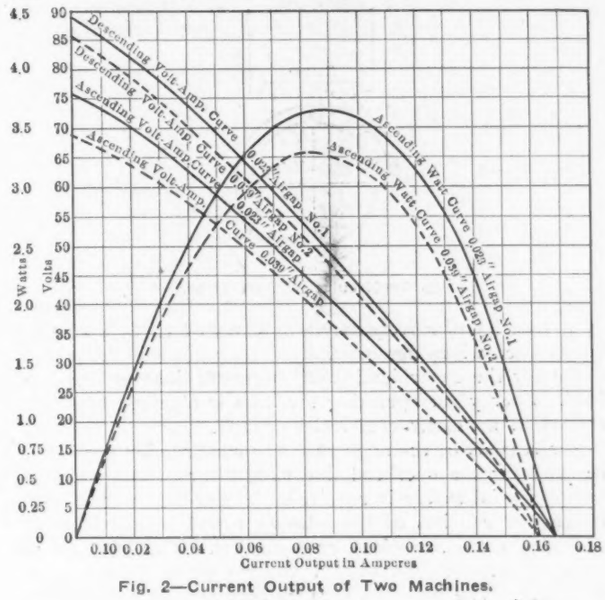


Fig. 2—Current Output of Two Machines.

while these machines are of standard construction, and, therefore, known as the regular 80-volt generator, the No. 1 machine, with the smaller air-gap, delivered about 245 volts at its highest emf, while the No. 2 machine, with the larger air-gap, had a maximum emf of 215 volts. In order to make the voltage measurement it was necessary to provide a contact upon the armature through which the voltage during a given instant could be measured. In order to accomplish the measurement a source of direct current was opposed to the current generated and when absolute balance was had in the potentials of the two sources current ceased to flow from one to the other and the emf of the opposing source of current was accepted as being equal to that generated by the armature at a given position. Upon reducing the emf curve to a sine-wave equivalent machine No. 1 produced the sine-wave *B* and machine No. 2 the form *C*.

Before leaving this subject reference may be made to Fig. 2, in which tests of the actual current output of the two machines are shown so as to compare the effect of the difference in the air-gap and the difference in the current delivered by the machines after they have been subjected to the demagnetizing influence of driving the machine with the armature windings completely short-circuited.

Referring to the diagram, it will be observed that machine No. 1, having the smaller air-gap, starts in with a voltage of 89 (the voltage measurements, it should be remembered, were made with a voltmeter having a resistance of 1500 ohms). Gradually increasing the load upon the generator while driving it at 1000 r.p.m., it is observed that as the current delivered increases the voltage drops until we arrive at a total current of slightly over 0.1675 amp. Now, without changing the conditions in any way, the load was gradually removed, with the result that when finally reduced to the voltmeter resistance, generator No. 1 delivered current at something under 76 volts. In other words, after building the generator and subjecting it to the short-circuiting operation, it was found to have dropped something under 15 per cent in the voltage which it was capable of generating.

In order to observe the effects of the larger air-gap machine No. 2 was started off at about 85½ volts and did not quite reach the 0.1675 amp point of machine No. 1, stopping at 0.161 amp, and, upon ascending, the voltage finally rested at slightly under 69, which gave a reduction of 19½ per cent.

From the above tests it will, therefore, appear that since it is impossible to prevent short-circuiting a generator winding while it is being driven, we find that the No. 1 machine at the beginning is about 4 per cent better, from a voltage standpoint, than the No. 2 machine, and that, after having been short-circuited, it is about 9 per cent better. It, therefore, is quite obvious that if an air-gap of 0.023 in. can be maintained efficiently from a mechanical standpoint, it will produce a generator about 9 per cent better than the machine having the larger air-gap. Reducing the voltage and ampere line to a watt curve, we are interested, particularly, in the ascending curve, *A* showing the No. 1 machine curve and *B* the No. 2 machine curve, from which it will be observed that the small-air-gap machine is about 11½ per cent better than the machine provided with the larger air-gap.

Upon attacking the problem of producing a generator which, after short-circuiting, might retain a greater percentage of its original emf, or, at any rate, prevent a loss of from 15 per cent to 20 per cent, several interesting experiments were conducted and a method was finally developed which permitted of increasing the initial voltages of the two generators from 15 per cent to 20 per cent; and upon short-circuiting the armature and driving the machine it was found that the drop of potential with machine No. 1 did not fall below 90 volts. This was accomplished by introducing a special method of magnetizing and by observing a few simple precautionary measures.

Referring first to Fig. 3, this shows a ring of iron broken at points *a* and *a'*, provided with a magnetizing coil *b*.

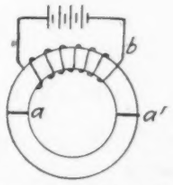


Fig. 3—Broken Ring with Magnetizing Coil.

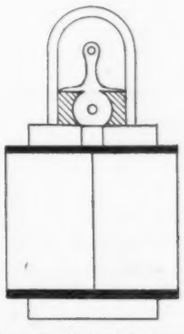


Fig. 4—Magneto Generator.

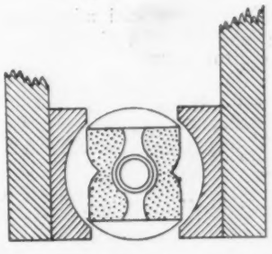


Fig. 5—Detail of Generator Shown in Fig. 4.

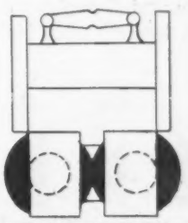


Fig. 6—Method of Short-Circuiting Pole Pieces.

Upon passing current through the winding it is well known that the ring magnet is magnetized and even after the current ceases to flow through the windings of the coil a considerable attraction is still observed between the two halves of the ring, this being due to residual magnetism.

This well-known phenomenon was applied to the magneto

generator shown in Fig. 4. Here we have an electromagnet of suitable power, built with the pole pieces so arranged that the magneto generator will rest upon the projections and permit the magnetic flux to pass through the limbs of the permanent magnet, which is shown more clearly by Fig. 5. The first experiments along this line were not very successful, owing to a large portion of the magnetic flux passing from pole to pole of the generator through the armature. The reason for this is clearly shown by Fig. 5.

Recognizing this as the cause for the failure, the armature was withdrawn from the generator and the magnetic flux resulted in thoroughly saturating the permanent magnets of the generator. While subjecting the machine to the influence of the magnet the armature was placed back into position, and, before interrupting the magnetizing circuit, the pole pieces of the magnet were short-circuited by a large block of iron, whereupon the current was interrupted and the generator removed from the pole pieces. Fig. 6 shows, in a diagrammatic way, the block of iron, mounted so as to permit its being slid up against the pole pieces to short-circuit them.

After removing the generator from the pole pieces the armature bearings were screwed into place, and, upon testing the generator so magnetized, an increase, sometimes as high as 25 per cent, was observed in the magnetism. Upon testing the machine for voltage, after short-circuiting, a drop of approximately 20 per cent was observed, which, however, still left the machine something over 17 per cent better, from a voltage standpoint, than could be brought about through any other known method.

When investigating the method of magnetizing telephone generators the first plan consisted in opening the circuit of the magnetizing coil after the armature of the generator had been placed in position. It was found, however, that a short-circuiting of the pole pieces before opening the circuit very materially increased the residual magnetism. In connection with this method of magnetizing it is necessary to observe the following precautions:

Under no circumstances must the armature be removed from between the pole pieces of the generator after saturation, for doing so will immediately drop the magnetization something like 20 per cent. Obviously, removing the separate magnets from the pole pieces will also result in the same reduction of residual magnetism, evidencing thereby that we have an effect with the permanent magnet exactly similar to that shown in connection with the description of Fig. 3.

As regards the lasting qualities of a generator magnetized according to the new method, the writer, so far as he has been able to determine, finds that it will last for many months, and, so far as the commercial value of the plan is concerned, it need only be suggested that one of the larger telephone manufacturing companies has, during the past six years, gained considerable commercial advantage through being able to produce a machine of a given power at a less expense for magnet steel.

MARTIGNY-ORSIERES SINGLE-PHASE RAILWAY.

ONE of the new single-phase railways of Switzerland is a line 19.3 km (12 miles) long from the Swiss government railroads at Martigny to Orsières. Its maximum grade is 3.5 deg. The line was built for electric operation with trains of one motor car and one or two trailers, having a maximum weight of 70 metric tons and carrying about 100 passengers at a speed of 30 km to 45 km an hour (18.6 miles per hour to 27.9 miles per hour), and with maximum freight trains made up of a maximum of 80 tons in motor-car weight and 50 tons in trail-car weight for operation at a speed of 15 km to 25 km an hour (9.3 miles per hour to 15.5 miles per hour). The freight motor cars are available for passenger service when required.

Direct current at 2400 volts was first considered for the line voltage, but the final decision was in favor of 8000 volts single phase on the trolley. It was intended to use

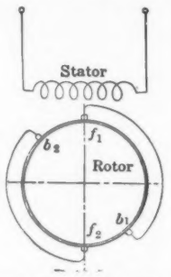


Fig. 1—Circuits of Deri Motor.

25 cycles, but the frequency was changed to 15 cycles to harmonize with the officially recommended frequency limits for the electrification of the trunk lines of Switzerland. Energy for operating the lines is obtained from the station of an electrochemical company.

For reasons of economy catenary construction could not be used for the overhead line except for certain sections where special safety is required. The trolley wire of the entire line consists of hard-drawn round copper wire of 50 sq. mm (No. 0 wire) cross-section. The brackets in open country are carried on wooden poles spaced 35 m (115 ft.). The normal clearance between the trolley wire and the head of the rails is 6 m (19 ft. 8 in.), but rises to 7 m (22 ft. 11 in.) at street crossings and drops to 4.8 m (15 ft. 9 in.) in tunnels. The insulation between the trolley and the brackets is threefold, namely, two trolley insulators of vulcanized rubber and porcelain and one grooved porcelain span insulator. The catenary brackets are furnished with double bell-type porcelain insulators which carry a seventeen-strand steel catenary. The trolley wire on the catenary section is suspended at intervals of 3 m (9 ft. 10 in). The spacing of the poles on the catenary section is 50 m (164 ft.), except at curves and switches. The rails are bonded with Brown's metallic alloy, in addition to which wire bonds are installed about every 100 m (328 ft.).

The present rolling stock consists of two passenger

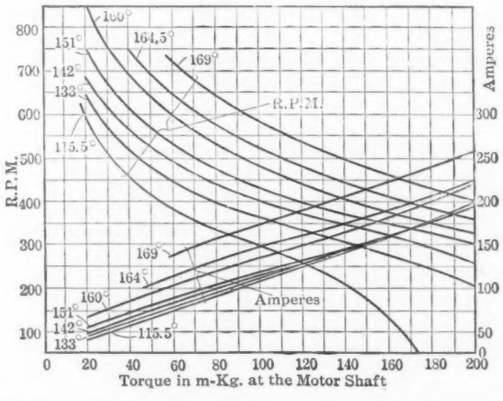


Fig. 2—Speed-Torque Characteristics of Deri Motor at Different Brush Positions.

motor cars, two freight motor cars, three passenger trailers and four ballast cars. All the motor cars have two plate-frame trucks of 2500 mm (8 ft. 2 in.) wheelbase and wheels of 1150 mm (45 in.) diameter. Every car, whether motor or trailer, carries a hand brake, straight air brake and an automatic brake. A separate system of brake levers

is installed at each end of the car to leave the rest of the underbody free for the electrical equipment. A connection is provided between both sets of levers to permit the operation of all brakeshoes from either platform.

The motor cars are of particular interest as they have been equipped with the Déri single-phase commutator motor furnished by Brown, Boveri & Company. This motor is of the repulsion type, and hence has a common

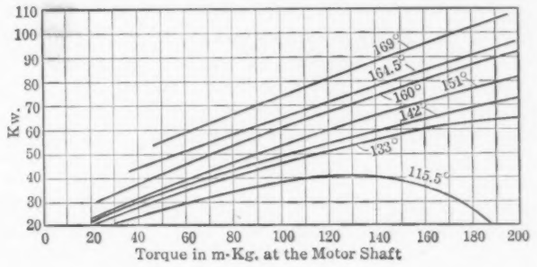


Fig. 3—Variation of Power with Torque for Different Brush Positions.

winding on its stator for compensation and excitation. The stator receives constant voltage and is connected to its rotor only by lines of magnetic force. As shown in the accompanying diagram, the rotor of a two-pole motor has two sets of brushes, *f*-1 and *f*-2, which are fixed permanently in the axis of the stator field, and *b*-1 and *b*-2, which can be turned around the commutator. One brush of the fixed and one of the movable set are connected by flexible cables; the other two brushes are similarly connected. When the motors are at rest both the movable and fixed brushes are in the axis of the stator field. The displacement of the movable brushes from zero position causes the turning of the motor. The rotor revolves in the direction opposite to the movement of the brushes and its speed increases according to the degree of brush displacement from zero position.

This motor has series characteristics, inasmuch as its speed drops with an increase in torque, but it also has shunt characteristics because its speed increases with an increase in the shifting of the brushes. Ordinarily motors of this type which have not been especially dimensioned for heavy starting currents will operate sparklessly with a starting current equal to about 2.5 times the normal output. Good commutation is secured for full-load running within limits varying from 50 per cent to 125 per cent of the synchronous speed.

The regulation of the Déri motor by mechanical brush shifting instead of voltage control constitutes its great

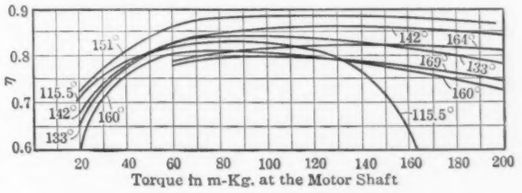


Fig. 4—Efficiencies at Different Brush Positions.

difference from other single-phase commutator motors. The characteristics of this motor may be summarized as follows:

It is always operated at constant voltage, hence the car transformer has only one secondary tap. Regulation does not occur by means of voltage steps, but is continuous, so that this motor really has an infinite number of running positions. No special reversing means are required, as the direction of rotation is changed simply by reversing the direction in which the brushes are turned. As this is a repulsion machine with a rotor independent of external circuits, it is especially suitable for high-voltage lines because the voltage due to induction and speed can be kept very low under all conditions. If desired the motor may be permanently connected in the zero position of the brushes, in which connection it consumes wattless magnetizing current only.

The prejudice against a motor of the brush-shifting type has hitherto prevented its use on railways, although small

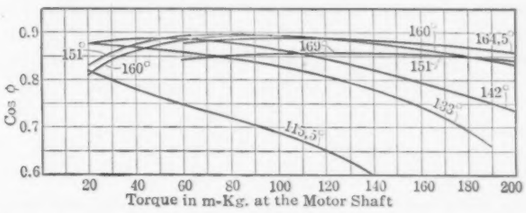


Fig. 5—Curves Showing Power-Factors at Different Brush Positions.

sizes have been built for cranes and mill work. The result of a year's satisfactory experimenting on the Stansstad-Engelberg Railway led to the introduction of this motor on the Martigny line. The manufacturers are now building 800-hp motors of this type for a number of important European lines, including the Dessau-Bitterfeld section of the Prussian-Hessian State Railways, the Bavarian State Railways and the Midi Railway of France.

The Martigny machine is a four-pole motor built for operation at 500 volts, 15 cycles. Its hour rating is 90 hp and its synchronous speed 450 r.p.m. The weight of the motor, gearing and gear case is 2500 kg (5500 lb.). Four motors are carried on each car, but the gear ratios differ in accordance with the speed requirements for passenger and freight service. The accompanying diagrams show the operating characteristics of this motor.

Current is collected at 8000 volts and transformed to 500 volts by transformers on the car. Pneumatically operated stator switches are provided to cut the motors out of circuit entirely without interfering with the transformer connections for the lighting and compressor circuits. The brushes are shifted by a combination of bevel gears, a cen-

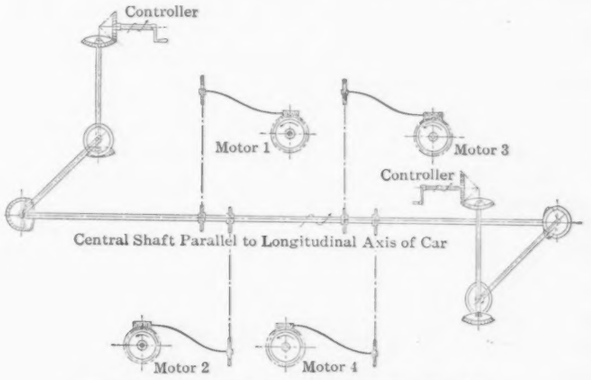


Fig. 6—Mechanism for Shifting the Brushes.

tral shaft parallel to the axis of the car, driving chains and flexible shafting, as shown in the accompanying drawing, Fig. 6. The brushes may be moved from zero to full-load position by no more than six turns of the controller handle. It is stated that the brush shifting is practically synchronous and uniform on all motors, and that the motors have operated successfully even when the line emf has dropped to 4000 volts.

A. I. E. E. PAPERS AND DISCUSSIONS

FOLLOWING are abstracts of a portion of the papers presented last week at the Chicago convention of the American Institute of Electrical Engineers, accompanied with abstracts of the discussions to which they gave rise. Abstracts of the following papers appeared in the issue of July 1, pages 5, 6 and 7: "Development of the Modern Central Station," by Dr. C. P. Steinmetz; "Tests of Oil Circuit-Breakers," by Mr. E. B. Merriam; "The Use of Reactances in Large Central Stations," by Messrs. R. F. S. Schuchardt and E. O. Schweitzer. Similar abstracts of the remainder of the papers and discussions will appear in a following issue. The papers, which are grouped so far as possible by subjects, are not printed in the order in which they were presented. On preceding pages a running report is given of the sessions of the convention, and of social and other events during its period.

DIAMETER OF INDUCTION MOTORS.

In a paper entitled "Choice of Rotor Diameter and Performance of Polyphase Induction Motors," Mr. Theodore Hoock showed from theoretical considerations that there exists for every rating one ratio of rotor diameter to core length for which the performance becomes a maximum. The power-factor, the copper losses, iron losses and overload range have an opposing influence upon this ratio. In order to work the material in the most advantageous manner for each item there would be obtained as many different diameters as there are items. It is not feasible to express all influences in one equation. The author therefore determined the proper ratio of core length to pole-pitch for which each item of the performance will become a maximum or minimum. The introduction of the leakage coefficient, that is, the ratio of the wattless magnetizing current to the ideal locked current, furnishes very simple formulas for practical application. The highest power-factor will always be obtained at an easily determinable ratio of core-length to pole-pitch.

The accompanying table shows the ratio of core-length to pole-pitch at which the power-factor, apparent efficiency and copper loss approach the minimum or maximum values of a certain frame ($D^2 l_i$) where D is the diameter and l_i the core length expressed in inches. The limits vary with the type, length of air-gap, type of winding, slot dimensions and number of poles.

$D^2 l_i$	Ratio of Core Length to Pole Pitch.		
	Best Power-Factor.	Best Apparent Efficiency.	Smallest Copper Weight.
20	0.2 to 0.3	0.5 to 0.8	2 to 3
200	0.4 " 0.8	1.0 " 2.0	3 " 4
2,000	0.8 " 1.4	1.0 " 2.0	3 " 4
10,000	0.9 " 1.5	2.0 " 3.0	4 " 5
300,000	1.3 " 1.8	3.0 " 4.0	4 " 6

The field of application or the characteristic of the type usually settles or limits the main dimensions. The peripheral speed, temperature rise, flywheel effect, method of manufacturing, ventilation, available floor space, shipping weight, load-factor, power consumption and factory cost are some of the factors determining the choice of the diameter within small limits and sacrificing certain parts of the performance.

Discussion.

Mr. E. F. W. Alexanderson, of Schenectady, said the value of the paper consisted of the author's methods of dealing with proportions. The motor designer must have a clear conception of the importance of changes in proportions. The leakage coefficient, as referred to in the paper, is the most important of all relations of the induction motor. The name selected is unfortunate, however, as not impressive enough to designate the very important effect involved.

Mr. C. J. Fechheimer, of Ampere, N. J., did not agree with the author's observations on temperature rise. The cost of copper, and therefore of the motor, must be considered by the designer in studying this branch of the subject, particularly in the case of small motors. Too much complication in mathematical calculations should be avoided.

Mr. H. Weichsel, of St. Louis, was glad the author spoke of "leakage coefficient" rather than "leakage reactance." The concluding table in Mr. Hoock's paper is of great value. Mr. Weichsel spoke of the advantage of standard patterns and tools in manufacturing induction motors. The table referred to will be an aid in such standardization.

A written communication was received from Mr. S. Harr, of Schenectady.

Mr. Hoock closed the discussion by saying that the long formulas were not intended to be used actually, but simply to show the development of the method. He made the interesting statement that no formula exists for predetermining objectionable noises, such noise, for instance, as would prohibit the use of an induction motor in a hospital or a hotel. The cut-and-try method is now used for this purpose.

SECONDARY CURRENTS OF THE SINGLE-PHASE INDUCTION MOTOR.

In a mathematical paper dealing with the wave shape of currents in the individual rotor conductors of the single-phase induction motor, Mr. H. Weichsel, of the Wagner Electric Company, discussed the complete cycles throughout which the currents in the secondary of a squirrel-cage induction motor vary. He concluded that the currents in the secondary when acting alone would produce a rotating field traveling in a direction opposite to the motion of the rotor and having a speed which is synchronous with reference to the line frequency. Superposed upon the rotor magnetizing current is the working current, which tends to produce an alternating field which is stationary in space and having an axis coinciding with the axis of the primary poles. In any individual rotor conductor this working current would be approximately unidirectional at a speed approaching synchronism, and at speeds different from synchronism it would have a low frequency, represented by the slip of the rotor from synchronous speed. He concluded that there are three distinct currents flowing in each rotor bar. One of these is the rotor magnetizing current, and the other two are components of the working current. The magnetizing current is of the same frequency as one component of the working current, and the total resulting current, therefore, consists of two different waves, one of which has a frequency equal to the line frequency plus the speed, and the other has a frequency equal to the slip.

ELEVATOR CONTROL.

A paper devoted to the control of elevators for office-building requirements was presented by Mr. T. E. Barnum, of the Cutler-Hammer Manufacturing Company. The author stated that two types of electric elevators have been developed to meet this service. One is the worm-gear drive with moderate-speed motor, and the other is the gearless drive with special low-speed motor. He claimed that the best results have been obtained by using an adjustable-speed motor, with a two-to-one speed range obtained by shunt field

circuit control. This arrangement gives an economical speed of one-half of the maximum.

By this means the operator is given positive control of the elevator speed, so that he can slow down to half speed quickly, regardless of the load. Slower speeds are obtained by introducing resistance in series with the armature and by shunting the armature with a resistor of low resistance. In this way it is possible to obtain a total effective speed range of eight to one. The paper contained a discussion of the details relating to the constructive features and operating characteristics of controlling devices for elevators using adjustable speed motors. The author gave data showing that the energy required to run an elevator cannot be predetermined with any degree of accuracy unless the service to be rendered is fully taken into consideration. Tests made upon actual installations showed values ranging from 2.4 to 10.4 kw-hours per car mile. The maximum value was obtained when the car was running with maximum load and with stops at all floors, while the minimum was obtained when running with two-thirds load with stops at only the top and bottom.

AUTOMATIC MOTOR CONTROLLERS.

Mr. Arthur C. Eastwood, of the Electric Controller & Manufacturing Company, presented a paper entitled "Automatic Motor Control for Direct-Current Motors," in which were described some recent developments in automatic motor control of the current-limit type, which have resulted in material simplification of the controller. This new type of automatic controller is known as the series current-limit type, in view of the fact that the magnetic switches which control the acceleration are series-wound and their windings are connected in series with the motor to be controlled. Use is made of a magnetically operated switch which possesses remarkable characteristics. The switch acts not only for closing the circuit and holding it closed, but also as a current-limit relay. If the current through the winding of a switch is below a certain critical value, the switch closes instantly, while if the current is above the critical value the switch will refuse to close until the current has been reduced to the critical value. The magnet-operating coil of the switch is so designed that the core is acted upon by two forces, one the magnetic pull at its upper end, which tends to close the switch, and the other made up of the weight of the moving parts plus the downward magnetic pull on the shoulder at the plunger. When the current is below a certain critical value the upward pull is greater than the downward pull plus the weight of the moving parts, and the switch will close; when the current is above this critical value the downward pull plus the weight of the moving parts predominates and the switch cannot close.

The author claimed that the switch is sensitive well within 10 per cent; that is to say, if the switch locks out positively at a given value of current it will close positively when the current has dropped 10 per cent below that value. This means that the maximum and minimum accelerating current values can, with the requisite number of switches, be kept within 5 per cent above and 5 per cent below a horizontal line which represents a predetermined accelerating current of constant value. Descriptions are given of numerous controller installations in which the series current-limiting switch was employed.

Discussion.

Following Mr. Eastwood's paper, Mr. E. J. Murphy, of Schenectady, N. Y., described a type of series switch unit employing a duplicate magnetic path construction similar in principle to the device described by Mr. Eastwood, but entirely differing from it in construction. Mr. Murphy's switch employs a pivoted armature with a rolling contact, thereby minimizing friction. For use with motors in which the starting current rises comparatively slowly, due to inductance, the inner or less reluctant magnetic path of the switch has to be inclosed in a copper damping coil. This coil prevents the rapid rise of magnetic flux in the normal path, deflecting the flux to the outer circuit, where it effects an attraction in counterbalancing the action tending to close the contactor.

In closing the discussion Mr. Eastwood said that in his early experiments with pivoted arms it was found that the presence of a conducting shunt or ribbon across the pivot introduced friction or residual forces interfering with the accuracy of the core's operation. In reply to inquiries, Mr. Eastwood also said that experiments have been made toward developing an alternating-current switch unit of similar characteristics, the outlook for which is very promising.

LIMITATIONS OF RHEOSTATIC CONTROL.

In a paper by Messrs. G. R. Radley and L. L. Tatum, of the Cutler-Hammer Manufacturing Company, the limitations of rheostatic control were considered under three heads, namely: Functional, where the limitations are inherent to the type of control; resistor material, where the limitations are due to physical characteristics of the resistor material, and switching devices, where the limitations apply to the method of adjusting resistance.

The authors discussed the fundamental features which determine the permissible variation in the power taken by the motor when controlling apparatus is being adjusted. They showed that, while the coarseness of steps permissible in a rheostat is limited by the requirements of the supply system, there is no functional limit to the fineness of the steps, the fineness being determined by commercial considerations alone.

The limiting features in the resistor relate to getting the electrical energy into the resistor and getting the heat produced out of it. The dissipation of the heat is by radiation, conduction or convection. In most designs of rheostats practically all of the heat must be carried away by the air and hence the highest efficacy is obtained when for a given amount of resistor material the quantity of air passed through the rheostat becomes the maximum. The authors showed that the permissible temperature rise is different in different parts of the rheostat. Thus the part which comes into contact with external objects must operate below a certain temperature, but when the resistor is provided with a frame and with screens to prevent the entrance of foreign combustible material the temperature limit can be much increased. As a rough average of commercial structures with natural ventilation, the surface temperature of an open resistor, such as a cast-iron grid, will be about 350 deg. C., with the air issuing from the top of the frame at a temperature of 175 deg. C.

For very large currents iron is a cheap resistor material, but difficulty is encountered in forming the terminals of iron resistors. The limit of temperature of wrought-iron or steel resistors is the plastic stage. For heavy currents cast grids reach a limit due to terminal features, while with low currents the limit is the ability to obtain sufficiently high resistance.

The limitations of switching parts are the carrying capacity and the commutating capacity, the latter including the ability to make as well as break a circuit. Of the commercially possible contact materials, silver is the best, with copper, brass and carbon following in the order indicated. Carbon has a relatively high specific resistance and a high contact resistance, but it is used very extensively as a material for sliding contacts, because of its freedom from welding and of its ability to withstand local high temperature without injury.

In summarizing a few of the factors which serve as short cuts to the consideration of sizes of rheostats, the authors stated that the maximum energy dissipation in a resistor of adjustable resistance in series with one of fixed resistance

across a given voltage occurs when the adjustable resistance in circuit is equal to the fixed resistance. When the voltage across the rheostat varies as a result of changing its resistance the series connection of steps affords the most efficient use of resistor material. However, when the voltage over the rheostat does not change greatly with the change in its resistance parallel connection of steps affords the best use of both the resistor and contact material.

ELECTRICALLY DRIVEN REVERSING ROLLING MILLS.

Mr. Wilfred Sykes, of the Westinghouse Electric & Manufacturing Company, read a paper reviewing some of the more important points in the design and operation of electrically driven reversing rolling mills. In rolling mills of the non-reversing type the fluctuations in demand upon the motor are minimized by the use of flywheels directly connected to the motor. In rolling mills of the reversing type the flywheel effect must be minimized, and no attempt is made to minimize the fluctuations in demand upon the motor. However, the fluctuations in the demand upon the supply system are properly minimized by the employment of motor-generator sets equipped with flywheels as an intermediate link between the supply system and motor. The motors employed in reversing rolling mills are of the constant-field, variable-voltage, direct-current type, the voltage being varied by means of a regulator in the field circuit of the generator on the flywheel motor-generator set. An automatic regulator for the motor-generator set is so arranged that when the load on the set exceeds the average value the speed of the set is reduced and the flywheel gives up part of the energy stored in it, thereby assisting the motor in driving the generator and eliminating the peak loads on the main supply system. During periods of light loads the flywheel is accelerated, and by properly designing the equipment the input can be maintained fairly constant. The author gave data relating to thirty-two reversing rolling-mill equipments now in service in Europe and three in this country.

The author claimed that in comparison with the three-high non-reversing rolling mills the two-high reversing mill has the following advantages: Where the mill has to roll a large number of different sections and operates for only a short time on one particular class of work the two-high mill is much more convenient than the three-high mill, there being a reduction in the cost of rolls, as well as in the time required for changing the rolls. The economy of the reversing mill with intermittent work is higher than that of the continuously running mill, principally on account of the elimination of the friction load when the mill is not in operation. Moreover, the auxiliary equipment of the reversing mill is somewhat simpler than that of the non-reversing mill, the lifting or tilting table being eliminated. The balancing arrangement of the rolls is also simpler, as only one roll is moved.

The paper contains descriptions of various devices that are employed for controlling the input to the motor of the motor-generator set. The motor is usually of the three-phase induction type, with a coil-wound secondary arranged for the variation of the resistance in the secondary circuit. In order to eliminate complications incident to the use of switch-controlled resistors, during the last few years the liquid type of regulator has come into extended use. The moving electrodes of the liquid regulator are operated by a small induction motor, which is supplied with current through a series transformer in the primary circuit of the main motor. The torque on this motor tends to separate the plates, and at normal load the motor torque plus that of the counter-weight just balances the weight of the moving electrodes.

An outline was given of the electrically operated reversing rolling mill of the Illinois Steel Company. This mill is driven by two direct-current shunt motors, having a total rating of 8000 hp. These machines are of the interpole compensated type with laminated field structure. The motor-generator set consists of a 6600-volt, 25-cycle, 1300-hp induction motor coupled to a double-commutator shunt-type generator of the interpole compensated type. The motor-generator set is equipped with two flywheels, each weighing 100,000 lb. The speed of the set is regulated by an automatic slip regulator, which consists of unit switches operated by two relays, one for dropping out the switches and the other for causing them to close, the different settings representing the limiting speeds between which the regulator operates.

Discussion.

In opening the discussion of Mr. Sykes' paper, Mr. K. A. Pauly, of Schenectady, N. Y., observed that there is in fact little difference in the energy consumption of reversing and three-high mills when operating at full load. The real determining factor, he said, is not alone in energy consumption, but in cheapness of operation, speed and the quality of material produced. Small mill plants often employ reversing rolls with greater success. A very large proportion of the energy required by the rolls may be due entirely to friction. The non-reversing three-high mill was introduced before electric drive, although there are some uses for which the reversing two-high mill is not applicable.

Mr. R. Tschentscher, of South Chicago, Ill., declared that the first reversing mill was operated in this country, at the South Chicago plant in 1906, being driven by means of an improvised motor-generator set. Among the advantages of the two-high mill over the three-high mill, is the possibility of instant stopping due to shut off; lessened maintenance due to fewer parts, less weight, and less speed of operating parts, making it possible for employees to anticipate repairs. The three-high mill is limited to a single kind of finished product, so that durng slack seasons the percentage of salable products is higher with the two-high mill. The speaker also pointed out that the latter has less roll friction and lower starting demand, requiring less generating plant equipment. The steel business, he added, has lately developed the output of alloy steels for the production of which the reversing mill is especially adapted in getting out limited quantities and material for experimental purposes.

In closing the discussion, the author of the paper repeated that while the reversing mill is not so well adapted for continuous, large output, it has a much greater maneuvering capacity for rolling a variety of shapes. The difference in energy consumption with high-carbon and low-carbon steels he attributed chiefly to the differences in temperatures at which these materials are worked. In shutting down an Ilgner motor-generator set the unit is frequently shut off and allowed to coast for some minutes while use is yet being made of the energy residual in its rotating parts.

THE DESIGN OF DIRECT-CURRENT ELECTROMAGNETS.

Mr. R. Wikander, of the Westinghouse Electric & Manufacturing Company, presented a paper recording some investigations concerning the design of the cheapest, most compact electromagnet to perform a certain duty. He discussed four different types of magnets, the continuously excited magnets designed for a certain final pull, the intermittently excited magnets designed for a certain pull, the continuously excited magnets intended for the performance of a certain amount of work and the intermittently excited magnets designed for the performance of a certain amount of work.

Concerning the first class of magnets the author concluded that the most economical density is always the one for which the corresponding part of the magnetization curve is a parabola. The absolute value of the density depends upon the permeability of the iron part of the circuit and upon the length of the air-gap, but it is the same whether

the magnet is designed for minimum volume, minimum weight or minimum cost. The ratio of the core diameter to the outside diameter of the winding is independent of the air-gap, the flux density and the ampere-turns, but depends upon whether the magnet is to be designed for minimum volume, weight or cost, and upon the relation of the volume of the total magnetic circuit to the core inside of the coil.

In relation to the second class of magnets the author drew the following conclusions: The most economical density is on that part of the magnetization curve which is below the "knee," and the value of the density depends upon the magnetic properties of the iron. The ratio of the core diameter to the outside diameter of the winding is independent of the air-gap, flux density and ampere-turns. He showed that in order to obtain an economical magnet of the third type the stroke should be chosen with as great a length as the conditions of the case will permit. The section of the core should be chosen so as to give a certain definite pull per square inch. The necessary ampere-turns per inch of stroke depend upon the ratio of diameter of core to length of stroke.

The ratio of the outer diameter of the coil to the diameter of the core is determined by the same conditions as apply to magnets of the first class. In designing magnets of the fourth class the stroke should be made as long as conditions will permit. The section of the core should be chosen so as to give a certain definite pull per square inch of plunger section. The number of ampere-turns per inch of stroke depends upon the ratio of diameter of core to the length of stroke. The ratio of outside diameter of the winding to the core diameter depends upon the same conditions which apply to magnets of the second class.

SERIES TRANSFORMERS IN THREE-PHASE CIRCUITS.

Mr. J. R. Craighead, of the General Electric Company, outlined by means of vector diagrams the operating characteristics of series transformers when used in three-phase systems. He showed that certain methods of interconnection of the secondary circuits of series transformers in three-phase systems resulted in the transformers carrying equivalent secondary loads which differ decidedly from those resulting from the use of the same devices with a plain series secondary connection. The power factor of the effective secondary load may be leading or even negative in extreme cases. The variations in the equivalent secondary load due to the power factors of the separate loads have a general tendency to offset one another. That is, when the power factor of one equivalent load is large in the leading direction the other is usually large in the lagging direction. When one equivalent load is increased the other is usually diminished. Therefore, these variations may be neglected in making approximate estimates of volt-ampere loads. The unbalancing of primary currents has a general tendency to increase the loads on interconnected series transformers, and where the circuit is known to be unbalanced to an unusual degree interconnections should be avoided, or the loads connected to the secondaries should be kept considerably below the amounts which are allowable under balanced conditions.

COST OF TRANSFORMER LOSSES.

In a paper by Messrs. E. C. Stone and R. W. Atkinson, of the Standard Underground Cable Company, was recorded an investigation of the losses produced in a system by the distributing transformers. It was shown that when the total cost of the losses due to the transformer is considered as 100 per cent the various elements will be approximately as follows: Iron loss from 40 to 70 per cent; magnetizing current loss from 1 per cent to 30 per cent; copper loss from 30 per cent to 50 per cent; regulation loss from 1 per cent to 10 per cent. By discussing the general relation of the cost of the losses to the amount of material in the transformer it was shown that for a given amount of material as the ratio of the losses is varied the copper loss of the transformer increases faster than the iron loss decreases, thus making the total loss larger, the larger the ratio of the losses. The amount of material in the transformers increases faster than the losses are decreased when the losses are varied by the varying size of the transformer. For lighting transformers the amount of active material varies at a rate greater than the third power of the loss.

Discussion.

Mr. A. H. Pikler, of Ampere, N. J., remarked the large amount of money invested in transformers and said that the subject of core and copper losses is therefore very important. The paper of Stone and Atkinson will be almost a classic because it goes into the subject of transformer losses so thoroughly and practically. Low-grade transformers can be sold cheaply, but they are dangerous, and this paper points out how high core density is dangerous. Low power-factor in the transformer is not objectionable when accompanied by low core loss. High-grade transformers show their superiority, especially where there are variations of voltage on line circuits.

Mr. W. C. Smith, of Pittsfield, Mass., said the depreciation factor is very important in the selection of distribution transformers. It is probable that the future will see a tendency toward higher operating temperatures. A temperature limit of 90 deg. is a fair estimate for present-day practice, but with the modern coil compounds known as "artificial resins" an ultimate temperature limit of 125 deg. may be reached.

Mr. E. A. Wagner, Ft. Wayne, Ind., said that magnetizing currents in transformers do not increase in proportion to the losses. In modern transformers the magnetizing feature is the "whole thing." The so-called "cheap" transformers may not be so bad as painted.

Mr. H. B. Gear, of Chicago, speaking as an operating man, said that transformer depreciation may loom above core losses and efficiencies. In the Chicago central-station system core losses amount to about 500,000 kw-hours a month, but even this is relatively small compared to the advantage that would be secured by methods adding from three to five years to the life of the transformer. Mr. Gear pointed out the difficulty in specifying transformers, owing to the mixed character of customers' requirements as to load-factor.

Mr. R. W. Atkinson, of Pittsburgh, who presented the Stone and Atkinson paper, closed by saying among other things that the cost of magnetizing current is the most variable factor entering into transformer losses. In buying transformers the requirements of each case must be figured out for themselves. Neither high-grade nor low-grade transformers are necessarily indicated.

HIGH-TENSION TRANSMISSION SYSTEM.

Four of the papers dealt with transmission systems operating at 100,000 volts. Mr. Max Hebgen gave data relating to the system of the Great Falls Power Company. This company operates a total of 282 miles of transmission line at 100,000 volts. The principal line is from Great Falls to Butte, Mont., a distance of 130 miles. Over this distance two separate, single-circuit tower lines are used, a single line being extended from Butte to Anaconda, a distance of 22 miles.

Mr. W. S. Lee submitted operating data in regard to the transmission lines of the Southern Power Company, Charlotte, N. C. This system was described in our issue for March 24, 1910.

Mr. J. P. Jollyman outlined the operating characteristics of the transmission installation of the Great Western Power Company, Oakland, Cal. The equipments of this company were described in our issues for Aug. 26, and Sept. 16, 1909. The main line from the plant on the Feather River to Oak-

land has a length of 153.6 miles. A branch line 1.1 miles long taps the main line 136.5 miles from the generating station. Both the main and the branch lines are of the double-circuit type.

Mr. P. T. Hanscom gave operating data relating to the system of the Central Colorado Power Company. This system was described in our issues for Jan. 27, June 23 and June 30, 1910.

LINE-CONSTRUCTION DETAILS.

On the Southern system the transformers are star-connected with the neutral point grounded. In the other systems the delta-connection is used without grounding. In the Colorado system both the delta and the star connections are used without grounded neutral.

Overhead steel grounded wires are used on all systems, the wires being grounded at each tower.

The standard tower spacing is 750 ft. in the Great Western and 600 ft. in the other systems. The maximum spans are 1600 ft. for the Southern, 3034 ft. for the Great Falls, 2740 ft. for the Great Western, and 2900 ft. for the Colorado. In all systems the three conductors are placed in a single horizontal or vertical plane. In the Southern system the spacing is 8 ft. 4 in. on old towers and 10 ft. 6 in. on new towers. In the Great Western system the spacing is 15 ft. In the Great Falls system the spacing is 10 ft. 4 in. The Southern conductor is No. 2-0, seven-strand cable of aluminum and of copper. The Great Western conductor is No. 3-0 copper cable. The Great Falls and Colorado cables are of No. 0 six-wire copper, with hemp core.

LIGHTNING.

Lightning has never caused any shutdown on the Great Falls system, although several severe storms have occurred since the system was installed. There has been no lightning along the Great Western system. On the Great Falls system there have been twenty-two shutdowns since Jan. 1, 1910, due to lightning damaging the 100,000-volt line or apparatus. On the Colorado system there were ten interruptions from lightning during the season from sixty-three recorded lightning storms along the high-tension lines. Electrolytic lightning arresters are used on all four systems, the operating results obtained from them being considered very satisfactory.

The charging kilovolt-amperes measured 6185 at 88,000 volts on the Southern system, 7330 at 90,000 volts on the Great Western system and 6800 at 100,000 volts on the Great Falls system.

INSULATION.

The insulators used are of the General Electric strain, Locke strain, Thomas strain and suspension types on the Great Western system; all have proved successful. In the Great Falls system the insulators are of the suspension type and consist of six units, 10 in. in diameter, with the under side of each unit corrugated. The caps and pins are cemented to the porcelain with Portland cement. The insulators have an ultimate strength of approximately 10,000 lb. and will flash over wet at somewhat over 300,000 volts. Up to the present time there has not been a single insulator failure, either mechanical or electrical. In the Southern system some hooks have pulled out of the insulators, but no line has been put out of service from this cause except during a sleet storm, when three hooks pulled out. On the Colorado system trouble has been caused by excessive winds shaking the conductors violently and mixing them up generally. It has been found necessary to dead-end the spans, increasing the horizontal stress, and in one span it has been found desirable to increase the spacing of conductors. During spring and fall months sleet and snow has collected on wires at the lower elevations, and in one instance before the line was placed in commission the accumulation of sleet and snow on a No. 0 conductor was found to be 1.9 lb. per linear foot.

The building outlets consist of porcelain bushings set into 5-ft. square slate slabs on the Southern system; plate glass windows 5 ft. square, without bushings, are used on the Great Western system, and oil-filled porcelain roof bushings are used on the Great Falls system.

Oil switches are used on the 100,000-volt side of the transformers in each system. These switches have given entire satisfaction.

The Great Falls system has been in operation at 100,000 volts for six months, and nothing has developed as yet to indicate that the operation is more difficult than that of a 50,000-volt system. The Southern system has been in service since Oct. 24, 1900. The Great Western system began service at 100,000 volts on Nov. 1, 1909. The Central Colorado system was first placed in operation on July 17, 1909.

Discussion.

In presenting at the high-tension transmission session the reports of the transmission systems of the Great Western Power Company, the Southern Power Company, the Great Falls Power Company and the Central Colorado Power Company, Mr. P. H. Thomas, of New York, who occupied the chair, discussed the conclusions of chief interest in these four reports. In general, it was declared, high-potential systems employing from 80,000 volts to 100,000 volts are quite as satisfactory as other plants operating at lower voltages. Many of such troubles as do occur on these high-potential systems are not directly due to the high-tension employed. Some of these plants are already near the corona limit, although at their present normal voltage they are not handicapped in this regard.

The reports refer with special interest to the operation and design of lines employing suspension-type insulators, the elasticity and inertia effects of which, it was suspected, might give trouble from mechanical motions of the conductor wires. Oscillations in the wires progress along these lines, becoming especially violent at passing points and near the ends where the stationary waves set up are of double amplitude. Such waves may bring oppositely charged wires within sparking distance of each other. The period and radius of swing, Mr. Thomas observed, is dependent upon the length of the suspension insulators, and where attempts have been made to allow factors of insulation safety by the insertion of additional disks long suspensions have been formed of large swing radius. The dangers of crosses from this source are sometimes overlooked in the design of lines where the insulation strength occupies the chief attention. When an intermediate pole or tower at a lower level is inserted to help carry a long span, tremendous lateral forces may be developed at the point of central support. The chairman also mentioned the spreading effects between conductors, due to short-circuits, and cited an instance where wires, after being thrown violently apart, were on the return swing twisted about each other with such violence as to make disentanglement a difficult task. The maximum span recorded is 3000 ft. and the worst sleet conditions reported have been a coating of 1.9 lb. per linear foot on a No. 0 conductor. Telephone circuits are operated successfully on transmission-tower lines with the aid of split inductances having their central points grounded.

Mr. H. M. Collbohm, of Madison, Wis., reported an instance where an aluminum arrester has been three times blown up during switching operations without the presence of lightning.

Mr. Paul M. Lincoln, of Pittsburgh, advised the grounding of the neutral through a resistance, but cited a Western case of direct grounding where customers are served single-phase high-tension energy over a single wire with earth return. Mr. L. C. Nicholson, of Buffalo, declared that the large current taken by a dead-grounded neutral sets up disturbances in neighboring circuits. He suggested the use of a resistance of about 1000 ohms in a 6000-volt neutral, limiting the maximum discharge currents to from 35 amp to 40

amp. This limited current may be used to control the automatic longitudinal sectionalization of the lines through ground detector relays. These relays have been found quite infallible in operation and permit the easy location of trouble.

THE ELECTRIC STRENGTH OF AIR.

Prof. John B. Whitehead, of Johns Hopkins University, presented a paper in which were recorded the results of recent investigations relating to the electric strength of air. The paper is supplementary to an earlier one presented by the author on the same subject, and deals with the fundamental relation between diameter and critical surface intensity, recording a series of investigations of the influence of stranding a conductor, the variation of atmospheric pressure and of frequency on the critical surface intensity. The term critical surface intensity, as used by the author, refers to the voltage gradient at the surface of a conductor at which the visible corona appears and the ionization of the neighboring air with accompanying conductivity begins.

The author stated that all of the facts and phenomena thus far observed indicate that the state of the air as regards ionization has no influence on the value of the critical surface intensity. He claimed that there is no experimental evidence in support of the contrary contention, and that in the present state of uncertainty as to the conditions controlling the critical voltage and the variation of the loss it appears unwise to confuse the problem by the introduction of an ionization theory.

As a result of the investigations recorded, the author concluded that the relation between critical surface intensity and the diameter of a clean, round conductor may be expressed by the simple law

$$E = 32 + 13.4 \div \sqrt{d}$$

E being the surface density in kilovolts per centimeter and d being the diameter of the conductor in centimeters.

Stranding a conductor lowers the critical voltage, and the lowering is greater the fewer the number of strands in the outer length. When expressed in terms of the diameter of wire in the same critical voltage the fraction of the over-all diameter of the stranded conductor for three strands is 0.7 and for nine strands is 0.88. With increasing frequency the corona starts at lower values of voltage, the lowering between 25 and 60 cycles being about 2 per cent, and about 6 per cent between 25 and 90 cycles. A linear relation exists between the atmospheric pressure and the corona-forming voltage for the range between 30 and 109 centimeters of mercury. The slope of this relation varies, however, with the size of wire, and the rate of change of critical voltage with the pressure is greater the smaller the diameter of the wire.

INVESTIGATIONS OF CORONA.

A paper by Mr. F. W. Peek, Jr., General Electric Company, contained a report of extensive investigations on the dielectric strength of air which have been carried on at Schenectady during the past few years. The result of these investigations was to confirm many of the results obtained by others, and to establish certain facts which had not previously been discovered. The author stated that as the voltage of a transmission line is increased until it exceeds a certain value, a loss occurs by dissipation of energy into the air, accompanied by the formation of visible corona. Luminosity of the air surrounding the lamp conductor does not begin at the disruptive critical voltage, but at a higher voltage designated by the author as the visual critical voltage. Visual critical voltage is much higher for small wires than is the disruptive critical voltage; it is also higher for large than for small wires, but to a less extent.

While theoretically no loss of energy should occur below the visual voltage, some loss does occur due to irregularities of the wire surface, dirt, etc. Loss of energy does not begin at the voltage at which the disruptive gradient is reached at the conductor surface, but only after the disruptive strength of air has been exceeded over a finite and appreciable distance from the conductor.

Concerning the effects of various atmospheric conditions and storms on the critical voltage and loss, the author stated that humidity has no effect on either the critical voltage or the loss; smoke lowers the critical voltage and increases the loss; heavy wind has no effect on the loss or critical voltage at ordinary commercial frequencies; fog lowers the critical voltage and increases the loss; sleet on the wires or falling sleet lowers the critical voltage and increases the loss; high voltages do not entirely eliminate sleet formations; rainstorms and snowstorms lower the critical voltage and increase the loss.

Discussion.

The discussion of the papers by Messrs. Whitehead and Peek was opened by Dr. Steinmetz, who remarked upon the momentous importance of these contributions in solving the limit of high-tension advances due to corona. Dr. Steinmetz then explained how corona starts, not when the potential gradient at the conductor reaches the breakdown point, but only after a conducting envelope which is formed has progressed an appreciable distance out from the conductor. A definite quantity of energy is thus required to start corona action, as is well known in the case of gaseous conduction. Dr. Steinmetz also complimented the investigators on the identical values of the critical voltages obtained in each case. The data presented shows that while free ionization or free humidity has no effect on corona, the presence of foreign material, such as fog, etc., exerts a profound effect. While Dr. Steinmetz admitted that he is not a believer in the ionic theory, he declared that he could see that this hypothesis permits of an easy explanation of corona production due to ionization by collision.

Mr. C. M. Davis, of Schenectady, explained how in the formation of corona the conducting envelope about the wire enlarges until a condition of equilibrium takes place and corona occurs, unless the wires are so close together that a disruptive discharge has already happened. Mr. Davis also brought out the fact that a point may be reached where disruptive, "puff" and corona discharges occur in succession between the same electrodes.

Mr. A. B. Hendricks, of Pittsfield, commented on the accuracy of the results attained and suggested the possibility of the corona voltmeter, proposed by Professor Ryan, which would make use of the visible and audible corona discharges. Such a device might have an accuracy within ½ per cent and could be used without the possibility of producing short-circuit, being in this respect superior to the needle-gap.

Mr. C. F. Scott, of Pittsburgh, spoke in general of the progress of high-potential transmission, referring in the course of his remarks to the accurate data and tests now available on the subject of long transmission lines and obtained with adequate instruments. These known facts extend the certainties and possibilities of high-tension transmission.

In closing the discussion Dr. Whitehead said that smooth, clean wires show no loss under potentials below visible-corona pressure, and Mr. Peek announced that the experiments which he reported are being continued and that further results are promised.

ELECTRIC-LINE OSCILLATIONS.

Mr. G. Faccioli, of the General Electric Company, presented a paper in which were described some tests performed on the 100,000-volt lines of the Great Western Power Company to obtain information on oscillations and rises of potential due to switching operations. The paper deals with some of the most important and representative records obtained by means of oscillographs. The following tests were performed: Switching in and out an open three-phase line at the generating station by high-tension switches; switching in and out an open three-phase line and step-up, three-phase transformers at the generating station by low-tension switches; switching in and out a three-phase line

connected at the end to an unloaded three-phase step-down transformer by high-tension switches at the generating station; switching in and out a three-phase step-down transformer at the end of an unloaded three-phase line by high-tension switches; switching, by high-tension switches, one of the three-phase lines when unloaded on and off the end of the other three-phase line while carrying its normal full load.

As a result of the experiments performed the author concluded that abnormal high potentials to ground, or between line conductors, or across windings of apparatus, are not to be feared. The maximum over-tension which the records showed was 60 per cent above the normal operating value. On the other hand, although extra high potential was absent, high frequencies were commonly produced. It seems, therefore, that the common method of protecting transmission systems by lightning arresters connected in series with a spark-gap does not answer the purpose effectively in all cases. The switching phenomena call mainly for protection against high-frequency impulses, the existence of which has perhaps not been properly realized in practical operation.

The author claimed that low-tension switching is preferable, when possible, to high-tension switching. There are two methods for energizing a line. According to the first the open line is connected to the generating system and the step-down transformer is thrown on to the end of the live line. According to the second the step-down transformer is connected to the dead line and then the line and the transformer are connected to the generating system. The tests recorded show that the second method is the better one, as it produced only one oscillation, and this oscillation was of the same character as the less severe of the two oscillations which took place in the first method of connection.

Discussion.

Mr. M. H. Collbohm, of Madison, Wis., opened the discussion of Mr. Faccioli's paper by drawing attention to the two principal points set forth therein; first, that the high harmonics present at no load disappear at increased current values, and, second, the production of high-frequency oscillations during switching. Mr. Collbohm cited an example of the occurrence of seventeenth harmonics of 5 per cent magnitude in a 66,000-volt, 25-cycle line, 63 miles in length. These harmonics produced no appreciable increase in the charging current. In view of the conditions pointed out in the paper, Mr. Collbohm said that the smoothness of the generator wave-form seems less important. For use where high-frequency oscillations meet reactances, building up high voltages, the speaker described the European method of applying a dry condenser element, shunted by a choke coil of high reactance, the condenser conducting off the high-frequency current, and the coil discharging the static accumulation. Mr. Collbohm also spoke of the successful application of solid iron conductors for station bus wiring, taking advantage of the high skin effect of these conductors for choking out high-frequency alternations. In the installation referred to a choke coil of Swedish iron is included in the busbar structure. As protection against high frequency at series transformers, electrolytic discharge cells have been connected across the terminals of the instrument apparatus.

Mr. D. B. Rushmore, of Schenectady, said that for years transmission systems have suffered unexplained disturbances and breakdowns at insulators, bushings and transformers, and added that Mr. Faccioli's paper is the first investigation actually to clear up the nature of the phenomena occurring in high-tension lines during switching operations. Insulation on high-tension lines is so strong that disturbances have now become fewer due to the magnitude of the causes themselves being below the factor of safety of the installation. The net result of these improvements is the increasing possibility of delivering uninterrupted supply of energy over long-distance transmission systems.

Mr. Percy H. Thomas pointed out that the facts of the paper form a valuable complementary study to the investigation of static phenomena presented at the Asheville convention. Dr. C. P. Steinmetz closed the discussion by reminding the audience of the tremendous range in the frequency which electrical waves may attain—from those of dying oscillations of 20 cycles per second up to wave frequencies of 20,000,000 cycles, which he estimated to be the frequency of a certain disturbance investigated at Schenectady.

CHARACTERISTICS OF TRANSMISSION LINES.

Three papers relating to the mechanical characteristics of transmission lines were presented as follows: "Solutions to Problems in Sags and Spans," by Mr. W. L. R. Robertson, Philadelphia Electric Company; "Sag Calculation for Suspended Wires," by Mr. P. H. Thomas, New York, and "The Mechanical and Electrical Characteristics of Transmission Lines," by Messrs. Harold Pender and H. F. Thomson, Massachusetts Institute of Technology.

Mr. Robertson reported the results of measurements made upon a certain 80-ft. span of wire at intervals of 8 ft. along the length, in order to show the deflection from a straight line actually existing between the points of support. These measurements were compared with calculations based upon the curve of the circle, the ellipse, the catenary and the parabola. The result showed that when the sag is small in value in comparison to the length of the span it is immaterial whether the curve is considered an ellipse, a catenary or a parabola, although an appreciable error may be introduced by considering it a circle. With greater sags, or when the supports are at different levels, the catenary formula most nearly represents the actual conditions. The author concluded that since the catenary formulas are on the whole as simple as any, the catenary curve seems to be the best to select for transmission-line sag calculations.

He presented in the form of curves the equations relating to the variation of the sag with the length of the arc as affected by the difference between the heights of support; the variation of the sag with the total stress upon the wire, and the dependence of the total stress upon the stress per square inch for different commercial sizes of wire.

In the paper by Mr. Thomas a description was given of a simplified method for calculating the sags and strains in suspended wires. The method is based on the assumption that the suspended conductor conforms to the catenary, and that the span is reduced in size to 1 ft. in length without changing the shape of the curve. The author stated that under these conditions the sag will be reduced in direct proportion to the reduction of span, and the stress in the wire and length of the wire will be reduced in the same ratio. He gave curves for showing the relations between the strain in the wire at the point of support and the sag in a 1-ft. span with a total load on the wire of 1 lb. per foot. From this curve the sag in any span can be found when the length of span, the total load per foot and the stress to be allowed on the wire are given. Dividing the allowable stress in pounds by the span in feet, and by the load per foot on the wire, gives the stress at the support on a span 1 ft. long of the same shape having a loading of 1 lb. per ft. The actual sag for the 1-ft. span as found from the curve being multiplied by the length of the span gives the sag of the actual span.

In the paper by Messrs. Pender and Thomson there were presented data and formulas, together with their derivations, required for the determination of the mechanical and electrical characteristics of transmission lines, together with a set of charts whereby the various mathematical operations involved may be accomplished readily and with the minimum of effort. The authors showed methods for determining the ratio of the total force acting on the wire to the weight of the wire, and then derived equations for expressing stresses,

etc., in the wire span. They showed that in all practical cases, except under extreme conditions of loading or for very long spans, the equations of the span wire may be represented with sufficient accuracy by the parabola, although for greater accuracy the catenary must be used. They presented methods for determining the variation in the tension and deflection of a span of wire with changes in temperature and with changes in the mechanical load such as may be produced by sleet and wind pressure.

Under electrical characteristics were discussed the resistance, reactance, capacity, susceptance and leakage of transmission lines, and there were developed approximate equations which are applicable for ordinary transmission lines.

Discussion.

In opening the discussion on the three papers having as their subject high-tension line construction, Chairman D. B. Rushmore directed attention to the unsuspected changes in line construction and design made necessary by advances in transmission practice. Mr. Paul M. Lincoln, of Pittsburgh, pointed out that for short spans of small sag, the parabola may be used for calculation with fair accuracy, although the catenary is, of course, more closely applicable to long spans. Mr. Lincoln also remarked that the stretch in the line due to yielding of supports, especially at angles, is often equal in amount to the elongation in the wire itself. Mr. L. C. Nicholson, of Buffalo, said that the spacing employed between wires should be chosen as much with reference to the length of span, sag, weight and size of wire as to the voltage to be employed. Heavy copper wires may be spaced more closely than lighter aluminum cables, since the latter are put up with more sag and are more likely to swing together. Mr. N. J. Neall, of Boston, observed that an engineer will sometimes experience more difficulty in learning to use a new, even if simpler, method of making transmission-line calculations than in sticking to his own awkward familiar method of computation. Mr. Neall also spoke of the difficulties of getting line-construction crews to follow specifications and dimensions in erecting towers and spans.

Mr. J. E. Balcomb, of Chicago, told of his own experience in line construction and operation among Western mountains and on the plains, where lines were subject to seasonable variations ranging from 140 deg. Fahr. in summer to the most severe sleet and wind conditions in winter. Mr. Balcomb said that the maximum sag in a span is found to occur not during the summer, but at times when ice and sleet coat the wire at the highest temperatures in which such coatings will persist. The greatest stress in a span occurs, he also pointed out, at times of high winds during low temperature. Mr. Balcomb suggested that some member of the Institute undertake a report comparing the actual line data reported by transmission companies with the calculated values based on the data which were presented before the convention.

Mr. W. E. Belcher, of Chicago, explained methods of correcting computed values of spans, sags and stresses, and recommended the use of suspension-type insulators for down-hill spans and for construction where the breaking of conductors might introduce large unbalanced forces. Mr. Belcher also recommended the use of spreaders in very long spans to prevent conductors swinging together.

DEVELOPMENT OF THE SUSPENSION INSULATOR.

Mr. A. O. Austin, of the Ohio Insulator Company, described in an instructive manner the characteristics of insulators which resulted in the changes in type and led to the final adoption of the suspension insulator for high-voltage work. He took into consideration the surface resistance, the mechanical shape of the flanges, the dielectric strength of the insulator to carry electrical stress, the distribution of stress in the insulator, the mechanical strength of the parts and the arcing characteristics as affected by dust, moisture, etc. He presented the accompanying table showing the design features and operating characteristics of two different 100,000-volt line insulators, one of which weighs 50 lb. and the other 90 lb. It was shown that the lighter insulator has greater mechanical strength, greater dielectric strength, greater flashover potential and less depreciation due to the loss of one section.

The author claimed that for the same cost the cemented type insulator is much more reliable than any interlocking type, for its connections may be tested, thereby eliminating the personal factor. He remarked that practice has shown that unless the interlocking parts are large the arc punctures may destroy the connections, because the interlocking connections do not always come into contact. Reliability in practice depends on the testing of insulators and connections, in order to eliminate any weak part. High mechanical strength is obtained by making the gripping surfaces effective and developing the full shearing strength of the cement, thus permitting the use of very small metal parts. The electrical advantages of scientific design are greater dielectric strength, higher surface insulation and lower depreciation. The economical advantages are lower cost of production, lower weights and lessened length.

COMPARISON OF 100-KV LINE INSULATORS.

	Type *A*	Type *B*.
Number of sections	6	4
Number of shells per section	1	2
Diameter, inches	10	14½
Length of insulator, inches	34½	41
Mechanical strength, pounds	10,000	8,000
Weight of porcelain, pounds	30	62
Total weight, pounds	50	90
Number of cemented joints	12	12
Formation of arc—dry	Through air	Over surface
Formation of arc—wet	Through air	Over surface
Total tested dielectric strength, kv	540	440
Minimum to maximum width of leakage path in per cent	16	10.6
Wet flashover	265	235
Depreciation due to loss of one section, per cent	16¾	25

Discussion.

Mr. E. E. F. Creighton, of Schenectady, N. Y., pointed out that the behavior of an insulator under a gradually applied potential is in no way indicative of its ability to withstand a sudden lightning or static discharge. During the gradual application of the potential the conducting envelope or path which spreads over the insulator surface permits the discharge to flash over the disk of the insulator, whereas the same potential suddenly applied would puncture the insulator. Mr. Creighton illustrated this point by citing the case of one insulator which was flashed over without harm several hundred times as long as the pressure was gradually applied, but which failed instantly by puncturing when submitted to a sudden electrostatic discharge. The speaker also showed how the multi-gap effect, present in suspension-type insulators, leads to spark-overs in case of high-frequency discharges.

Mr. Paul M. Lincoln, of Pittsburgh, said that flash-over tests on insulators show practically the same voltage values for wet as for dry tests, illustrating that while the surface leakage of the wet insulator is of course much greater than in its dry condition, this difference is offset by the superior insulation offered by the capacity effect. Mr. P. H. Thomas compared the multi-gap effect shown by a lightning arrester with the sparking cylinders arranged in the familiar V pattern and in a straight line.

In closing the discussion the author of the paper declared that while there is possibly a fatigue effect in porcelain, it is so slight as to be practically non-observable. Often, however, trouble is caused by poor burning of the porcelain, which is sometimes ascribed to fatigue, but which is in fact due to improper vitrification.

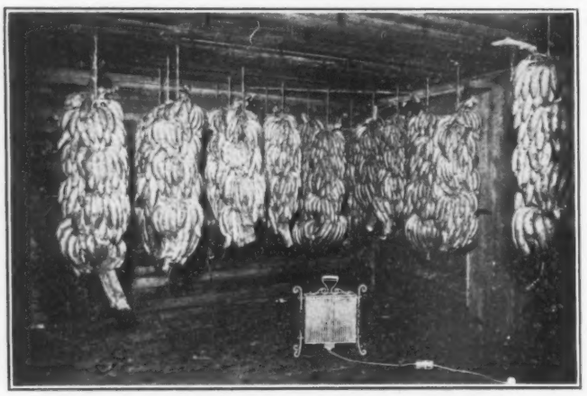
Central Station
Management, Policies and Commercial Methods

ECONOMY OF ELECTRIC TOASTERS IN A RESTAURANT.

Illustrating the advantages of using electric toasters in restaurants, Mr. J. D. A. Cross, heating specialist for the General Electric Company, in an address before the Michigan Electric Association, June 21, cited a striking instance of electric economy over a gas-heated toaster in a restaurant at Pittsfield, Mass. The gas-heated toaster formerly used cost 35 cents a day, using dollar gas; the 3500-watt electric device now employed costs but 10 cents per twenty-four hours, at 8 cents per kw-hour. The new electric toaster can prepare six slices per minute, or 360 per hour, and from it 200 to 250 orders of toast are ordinarily served in twenty-four hours. The consumption averages 10 watt-hours per slice of toast. The proprietor is much pleased with the electric device, declaring that it operates 60 per cent faster and is cleaner, handier and in all ways better than the gas toaster. The central-station income from this particular restaurant toaster ranges between $3 and $10 per month.

ELECTRIC RIPENING OF BANANAS A TWENTY-FOUR-HOUR HEATING LOAD.

The fruit and commission house of Leisman & Company, 102 West Jefferson Street, Louisville, Ky., ripens large numbers of bananas for the local business in basement compartments heated by an electric radiator or air heater. Two years ago this firm occupied a building with a fruit dealer who used gas to heat his ripening cellars. One day the gas exploded, wrecking the building and causing large damage. After suffering from this disaster the Leisman company determined, when it later added a banana department to its lines, to find some safer means of heating for ripening its fruit. Electric radiators were tried and have proved much more satisfactory than the old means.



Electric Heater Used to Ripen Bananas in Louisville Commission House.

The ripening rooms comprise two 8-ft. x 10-ft. compartments, with 6-ft. 6-in. ceilings, which are separated by double partitions with intermediate air spaces from the rest of the cellar. In rows on the ceiling of each room are placed eighty hooks, each capable of supporting a bunch of from 150 to 225 bananas. Such bunches weigh from 60 lb. to 90 lb. each. A Simplex resistance-type air heater, consuming from 1200 watts to 900 watts at its three temperature steps, is placed on a zinc mat on the floor and holds the room temperature at the desired range of 60 deg. to 80 deg. Fahr. For ripening, a process requiring forty-eight hours, a temperature of 75 deg. to 80 deg. Fahr. is needed, and for storing the fruit after it has ripened the temperature should be 60 deg. to 70 deg. Fahr. The three-heat switch on the heater enables this regulation to be made nicely. During ripening the bananas give off a great deal of steam and moisture, which sometimes causes trouble by extinguishing the flame where gas is used, leading to explosions of the kind already cited. The electric heater, of course, is proof against such interruption. The chemical processes of ripening of themselves give off an appreciable quantity of heat, which aids in the ripening process.

The heater is operated on its middle temperature step continuously throughout the twenty-four hours during all but the very warm summer months, when the ripening process goes on without artificial heat. During an average month's use the heater recently consumed 495 kw-hours. For this energy, at its 5-cent rate, the Louisville Lighting Company received $24.75. The average monthly consumption and income for the electric company have been about these figures. As will be noted from the foregoing, the equipment provides for ripening about 32,000 bananas every forty-eight hours, although, of course, the local market does not demand this quantity, and during most of the time the fruit is simply held in warm storage pending distribution. Curiously, as above intimated, less artificial heat is required to ripen a room fully filled with bananas than only a few bunches, on account of the quantity of heat given out by the ripening processes themselves. The merchant expresses himself as thoroughly pleased with ripening by electric heat after ten months' experience with the new process.

Such twenty-four-hour large-demand heating uses doubtless exist in every city where bananas are ripened for distribution, and, on account of the continuous long-hour character of such loads, it should be possible to make a very satisfactory rate for energy. The accompanying illustration of the electric radiator in use in the banana cellar is kindly furnished by Mr. A. T. Macdonald, traffic manager of the Louisville Lighting Company and editor of its attractive and popular publication, *Chained Lightning*.

TRANSFORMER PRACTICE AT GRAND RAPIDS, MICH.

All lighting and motor-service transformers on the Grand Rapids-Muskegon Power Company's lines are fused on the primary side. The fuses and fuse boxes, which are made up in the company's shops, were described by Mr. Howard Pett, before the Michigan Electric Association, June 20. The fuse consists of standard fuse wire inclosed in a ⅜-in. glass tube, 12 in. long, equipped with brass clips on the ends. These clips fit into brass terminals mounted on standard porcelain insulators, the whole being inclosed in a box screwed to the cross-arm. The box is made of ⅞-in. pine, well filled, and fitted with entrance bushings for the wires. One side of the box is hinged to allow the renewing of the fuses and is provided with a catch to hold it shut. The bottom of the box is left open to allow the escape of gases formed when a fuse blows and is covered with a strong wire screen, with ¼-in. mesh, to keep out birds.

Every transformer is inspected once a month and samples

of oil are drawn out into bottles, labeled with the number of the transformer and sent to the shops of the line department. The oil is tested and results of the test are sent to the foreman. All transformer oil must stand up under an insulation test of 27,000 volts between a spark gap of 0.15 in. If it does not come up to this standard notice is sent to the foreman in charge and the oil is changed.

It is a question at present, said Mr. Pett, whether it is necessary to subject the oil from every transformer to this test as often as once a month. The time may be lengthened except in instances where a transformer is heavily loaded or is working on potentials in excess of 7200 volts, which is used for distribution at Grand Rapids.

An experiment is being tried out in connection with transformer protection in Grand Rapids by inserting choke coils in the primary wires leading in and out of the transformer fuses. This coil is made by giving the wire seven turns around a ⅝-in. bolt. The ends of the wire are then brought back through the coil and pulled up tight. There were many serious electrical storms in western Michigan during the last week in May and the first week in June and the results observed would seem to indicate that these coils afforded considerable protection. In many instances after a storm the fuses were blown and the fuse boxes totally destroyed, but transformers protected by these coils seemed to suffer damage. Outside of the apparent protection that these coils seem to afford the advisability of using them has not been fully decided upon, but will be determined by future tests.

CONCRETE LAMP-POSTS AT ANN ARBOR, MICH.

A number of concrete tungsten-lamp posts have been erected at Ann Arbor, Mich., at a cost of $7.48 per pole. The posts are 25 ft. long, 8 in. in diameter at the base and 5 in. at the top, and are reinforced with four ⅜-in. steel rods, one at each corner. Complete, the posts weigh 1185 lb. each. Six inches from their tops single arms or buck arms are cast into the concrete, 1½-in. x ⅝-in. x 18-in. steel angles being used. These arms are bored for ⅝-in. bolts, which support the insulators carrying the line wires. Nineteen feet from the butt of the pole three ½-in. bolts are cast into the concrete for carrying the lamp bracket.

Fig. 1—Post Loaded for Transfer to Place of Erection.

The posts are set 5 ft. into the ground, bringing the lamp 12 ft. above the curb. On each post are stenciled the number of the lamp and its circuit.

The wooden forms required for the construction of these poles cost $200 to build, $155 of which was for lumber and mill work. A concrete mixture of one part Portland cement, two parts sand and four parts ½-in. crushed limestone was used, the cement being mixed wet and poured and troweled in the form. The posts were allowed to set

Fig. 2—Electric Truck Raising Post Into Position.

two days and then to lie on the form base four days longer. after which they were seasoned for ten days before erecting. The cost of 100 poles was made up as follows:

30 tons crushed stone, at $2.60	$78.00
18 tons sand, at $2.75	49.50
47 bbls. cement, at $1.60	75.20
4300 lb. reinforcing steel, at 2.58 cents	110.94
600 lb. cross-arm steel, at 2.20 cents	13.20
Labor	420.00
	$746.84

The average cost per pole was thus about $7.47 each, exclusive of the first cost of the forms. The poles were distributed by loading them onto a carrier drawn by an

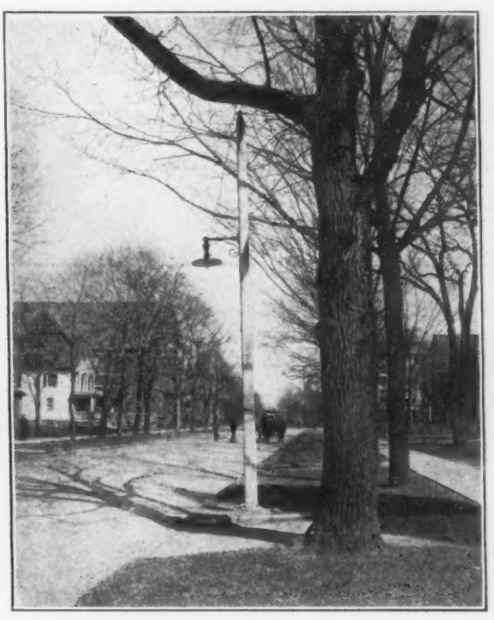


Fig. 3—Concrete Tungsten-Lamp Post Complete.

electric truck. On reaching the place of erection the truck was connected to tackle and the pole raised into position by running the truck off at a distance. In a paper on street lighting, read before the Michigan Electric Association, June 20, Mr. R. M. Hemphill, Jr., manager of the Wash-

tenaw Division of the Eastern Michigan Edison Company, expressed himself as well pleased with the appearance and service shown by these poles, the design of which he attributed to Mr. Edward Richards, of the Toronto Hydroelectric Commission.

ELECTRIC-POWER REQUIREMENTS IN A MANUFACTURING PLANT.

A THOROUGH investigation of the conditions in a Western metal-products factory was lately made with the object of determining the actual consumption of electricity by machinery in various departments of the establishment. The tests were carried out with unusual detail and extracts from the data secured are given below.

Iron Foundry, Tumbling Barrels.—Two barrels, on shafting; size of barrel, 36 in. and 48 in. diameter. Usual load is one barrel, but about 25 per cent of the time both are run. Speed of shafting, 196 r.p.m. Shafting required 2.75 hp, running light, and each barrel required an average of 1.55 hp (1.7 hp for larger and 1.4 hp for smaller barrel). Average power demand, 4.3 hp; maximum, 5.8 hp, with both barrels in service. A 5-hp squirrel-cage induction motor is ample for the work.

Iron Foundry, Compressor.—Bury Compressor Company, class BB, 10 in. x 10 in., driven from short jack-shaft. Chain drive could be used if space is available. Heavy service, full-load running test, 17.6 hp. To run compressor with free discharge took 4.1 hp at jack-shaft. Compressor was rated at 136 cu. ft. per minute at 100 lb. pressure. Squirrel-cage induction motor of 20-hp rating satisfactory.

Iron Foundry, Sand Sifter.—Driving pulley, 12 in. diameter, 6-in. face; speed 630 r.p.m. Power consumption of sifter running light, 0.38 hp; momentary maximum load when running with both sides of sifter full, 1.3 hp. Test showed that a 3-hp motor is ample for service, instead of existing 5-hp motor.

Bread-Maker Department.— Total number of machines in department, sixty-five. All machines off, friction drive, 12 hp; ten machines on, 15.3 hp; heavy load, 75 per cent of machines running, 18 hp.

Box Nailer.—Nailer was a No. 8 Morgan, running 300 r.p.m., with 22-in. pulley. Motor in use, an Allis-Chalmers 2-hp, 110-volt outfit, 1150 r.p.m., 5-in. pulley. Running nailer and motor free, 330 watts; driving two nails, 880 watts; driving four nails, 1100 watts; driving five nails (maximum duty), 1210 watts. Test showed that 2-hp motor is ample for work in hand.

Chopper Department.—Department contained about 110 small machine tools, 102 of which were connected to a line shaft driven by a 50-hp General Electric 500-volt motor. Tests showed that shafting friction load was 12.3 hp; 102 machines running and fifty-nine working took about 38 hp, which was normal load. The total length of line shafting was 510 ft., and the shaft diameter 2 7/16 in., with ring oiling bearings in good condition. A very heavy occasional load, with ninety-six machines running, required 42.5 hp.

Percolator-Urn Department.—Number of machines, twenty-seven, including ten spinning lathes. All belts running on loose pulleys, 7.4 hp; all machines running free, 16.6 hp; heavy load, all but three machines running, 18 hp. Test showed that the power required in actual machining was very small in proportion to that consumed in running shafting and machinery apart from load.

Aluminum-Percolator Department.—Equipment consisted of thirty-seven small machines, including four spinning lathes, 96 ft. shafting, one milling machine and small drill press. Running machines free, 12 hp; running shafting only, 5.3 hp; all machines on, usual work, 18 hp. Second test gave usual load of 12.4 hp, and occasional peak of 15.4 hp.

Cleaning Off Urn Buffers.—Equipment consisted of twenty-four buffing lathes and a 35-in. exhauster. Test showed power consumption with everything except exhauster off of 18 hp; all machines running free, 36 hp; same as preceding with eighteen men working, 44 hp; maximum peak load noted, 50 hp; allowance of 1.8 hp per buffing lathe on hard work. Another test on buffers and finishers gave 0.4 hp per machine when off the line shaft, 0.9 hp per machine when running light and 1.2 hp per machine on normal finishing work.

Aluminum-Percolator Buffing.—Equipment consisted of 45-in. Sturtevant double exhauster, 700 r.p.m., and eight double buffers and six smaller single buffers. Line shaft running with exhauster and fourteen loose pulleys, 14 hp; all wheels running free, 21.3 hp; all buffers working, 33 hp; maximum load noted, 40 hp; line shaft and blower required, 8 hp. Unit results: Power per buffer (loose pulleys), 0.47 hp; power per buffer run free, 0.99 hp; power per buffer under normal operation, 1.82 hp.

Hardware-Plating Department.—Equipment driven included one 60-in. Sturtevant exhauster, one 1500-amp plating dynamo, two plating rolling barrels and four small brush lathes. Test showed that plating barrels and lathes could be started by 8.1 hp. Exhauster, four lathes and dynamo, running free, required 6 hp; adding the two plating barrels required 6.7 hp, and operating all the equipment and supplying 600 amp at 6 volts to the barrels required 14.6 hp.

Printing Department.—In this department five small job presses, one 28-in. paper cutter, one No. 3 Miehle cylinder press, one stitcher, a jig saw, a circular saw, a Whitlock pony cylinder press and a slow-speed exhaust fan were driven by a 15-hp motor running 1200 r.p.m. The motor pulley was 34 in. in diameter, and it was belted to a line shaft running 285 r.p.m. With all this equipment off except the exhauster and flywheel of the paper cutter the department required 2.33 hp. With all machinery in service 5.7 hp was required. It appeared desirable to install a 10-hp motor to insure easy starting.

Stag Room.—In this room were a 45-in. Sturtevant exhauster running 1200 r.p.m., nineteen small bench tools, a small exhauster and thirty stands for hand grinding. Twenty stands were connected to the exhauster, giving a total of 250 sq. in. of openings. In the tests the starting power required was 20.6 hp. With all the equipment running on loose pulleys, with grinding wheel belts loose, but exhausters running at full load, the power required was 13.3 hp. With all machinery running on loose pulleys but with twenty-one wheel belts on spindles 15.3 hp was needed; with all machinery on loose pulleys and twenty-one wheels running free 17.3 hp was required, with an increase of 20 hp when thirteen wheels were manned. The power required with everything running free and with thirteen wheels manned was 22.6 hp. The average power per wheel was 0.53 hp, and 0.2 hp was required to run the wheel free in addition to shaft friction.

A test in the fork and handle-finishing department showed that 100 polishing and grinding wheels required about ½ hp each. In the cutlery-plating department tests showed that the average power consumption of nickel tanks was 0.65 hp each; of silver tanks, 0.68 hp each, and of stripper tanks, 0.70 hp each. For this class of work a general allowance was made of 0.7 hp per tank.

Machine-Grinding Department.—Motor drive of thirty-four standard knife-grinding machines, two large knife grinders and two hand emery wheels. Power required to run equipment with loose pulleys, 22 hp; with equipment running free but doing no work, 40 hp; with thirty-four machines loaded, 86 hp, or an average of 2.53 hp per machine when bearings had just been oiled. With thirty-four small machines and two large machines in operation

100 hp was required. To start the equipment required 1.8 hp per machine.

Machine-Glazing Department.—Two groups, or forty-eight total machines, driven by 30-hp General Electric motor. The spindles are run except when temporarily shut down for repairs and are started in the morning with the belts on tight pulleys. The starting power required was 37.7 hp; with forty-eight machines running free there was required 28.5 hp. With forty-eight machines running and forty-four working 38.2 hp was required. With all machines working (100 per cent load-factor) 0.81 hp per machine was demanded. Further machine-glazing service utilized a 75-hp motor driving 100 glazing machines, nine polishing wheels and two small machine tools. The starting duty was so severe that the motor was arranged to start only five lines, or fifty-eight glazing machines, at a time. After full speed is attained the remaining machines are started by shifting belts. When 100 glazing machines and nine polishing wheels were run free the power requirements were 40 hp. With 100 machines running and eighty working, with three of the polishing machines, 70 hp was required, this being an average heavy load. The net power required per glazing machine was 0.67 hp, with 80 per cent of the installation working.

Celluloid Department.—A 30-hp motor drives five variety shapers, four bench tools, one roll, three kneaders, two tube machines, one hydraulic pump and five small speed lathes on one floor, and thirty-five standard polishing and grinding wheels, one sander, eight small bench tools and four exhauster and blower equipments. Power required to start, 34.8 hp; all machinery off except exhausters, 23 hp friction load; first floor heavy load, second floor off, 39 hp; second floor heavy load, first floor on loose pulleys, 31 hp; second floor heavy load, first floor entirely off, 28 hp; both floors on, heavy work, 41 hp. Exhausters take 8 hp.

In the basement of the celluloid department there are driven four double tumblers, one pulverizer, three small drills, one punch, one swage and two small circular saws. In the hallway are a small shear and belted elevator taking 9 hp at the peak load, and at the west end of the plant are ten 8-in. single grinding and buffing lathes, with a Sturtevant No. 40 single exhauster with a total opening of 275 sq. in. With the exhauster running at full load and everything else off 8 hp was required; with the first group of machinery running free, 11.3 hp; with all equipment running free, 12.7 hp; with all equipment running free except that used by nine men buffing, 14 hp; with everything running free and both groups working, 12.7 hp; and with normal load, 14 hp. A 23-hp peak was noted on starting the elevator, with the rest of the equipment running.

Pressroom, Hardware Building.—A 35-hp motor drives eight heavy direct blanking presses, six medium blanking and piercing presses, five large Bliss back-geared drawing presses, thirteen medium presses, eleven light punch presses, one sheet-steel shear, six small machines and one elevator for foundry. The friction load, with all machines on loose pulleys, was 9.4 hp; with all flywheels and countershafts running, 16 hp; with preceding service in operation and seventeen men on light work, 22.7 hp maximum; with all machines running, 35 hp.

Coffee Mill and Grinding Machines.—Foundry equipment, one 6-in. x 6-in. air compressor, 85 r.p.m., 55 lb. pressure; one rotary blower, one tumbler (did not run during test); coffee-mill department, eleven medium and nine small special machine tools; grinding-machine department, twenty-two average light machine tools. Coffee department has twelve light machine tools and one elevator. Five men working on tools in coffee department and ten on grinding machinery. With all machines on loose pulleys, 12.7 hp; with compressor and blower on, 16 hp; foundry with coffee-mill present load, 18.7 hp; foundry with present grinding-machine load, 21.3 hp; everything on, present load, 24 hp; with 95 per cent of present machine tools running and fifteen men working, 32 hp.

Brass and Scale Departments.—Machinery driven includes two special cock grinders, four grinding wheels, one Buffalo 35-in. single exhauster, thirty-three small machine tools and twelve dry tumbling barrels and elevator. During test ten men working, frequently fifteen. Scaleroom contained twenty-eight small machine tools and five grinding and buffing lathes, with twelve men working during test. Test showed that with all machinery off on loose pulleys 10 hp was required; running tumblers, 11.3 hp; all tools free in brass department, 16.7 hp; same with ten men working, 18.7 hp; running all scale department free, with thirty-three machines, 16.7 hp; momentary peak, 22 hp; both departments normally running, 20.7 hp average. Elevator starting adds a momentary peak of 5.3 hp.

Drop Department Hardware.—Motor (35 hp) drives five large drops of about 800 lb. each, two light drops of 200 lb. each, four foot drops, one No. 5 R. G. F. blower, two wire cutters, two turret lathes, two bench lathes, eight tumbling barrels and one small circular saw. The test showed that with everything off except the blower 10 hp was required; with eight barrels running 12 hp was needed; with about 1000 lb. drop work under way, 23.3 hp peak; with six large drops working, 37 hp peak, and with all men working in addition, 37 hp peak and 30 hp average.

Carpenter Shop.—Equipment consisted of one 16-in. hand-feed circular saw, one band saw, one grindstone, a sensitive drill and a speed lathe. With all tools off, 2.7 hp; with band saw on 8-in. heavy work, 4.7 hp; with circular saw on 5-in. rip in heavy spruce, 7.4 hp; with both saws on heavy work, 10.7 hp.

Steel Cutting.—Equipment, one medium 8-in. alligator shear at fifty-two strokes per minute and one small 8-in. alligator shear at eighty-three strokes per minute; large shear cutting 5 7/16 in. x 3/16 in. at each stroke, heavy work, and smaller shear two strips, 1¾-in. x 1/16-in. work; with flywheels and shaft running free, 2 hp; with both shears on heavy work, 3.3 hp. In the shafting-room thirty-seven light wood-working machines took 32.4 hp.

Wiring and Illumination

MITERING METAL MOLDING.

By G. A. HARRIS.

In a recent issue of the *Electrical World* a method of forming turns and elbows in metal molding was described in which the base was cut in two at each bend or elbow. This necessitates the insertion of a "conducting-piece" at

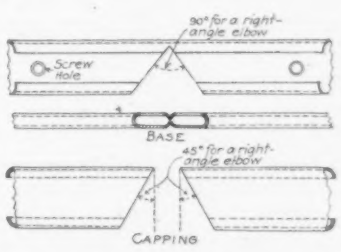


Fig. 1—Miter Cuts for Elbow.

each turn or elbow in order that the electrical continuity of the molding may be maintained. If the base is sawed in accordance with the instructions given, the "conducting-piece" may be eliminated. Fig. 1 illustrates how a piece of base is cut to form a right-angle elbow, leaving a portion of one edge intact to afford conductivity. After cut-

ting the two ends of the base are bent together until the two cut faces abut. The two end lengths will then be at right angles to one another. Cappings for such a 90-deg. elbow are mitered, as shown at the bottom of Fig. 1, and

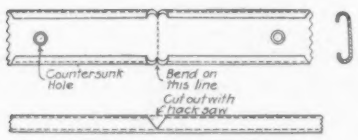


Fig. 2—Miter Cuts for Bend.

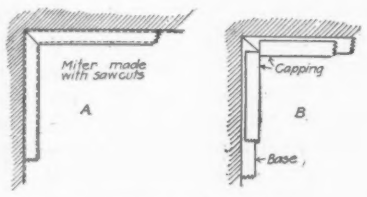


Fig. 3—Mitered Inside Bend.

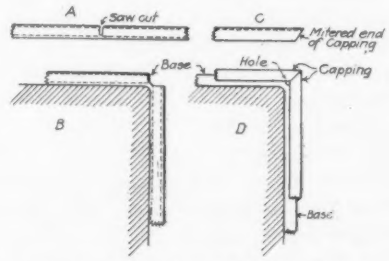


Fig. 4—Mitered Outside Bend.

are snapped over the base after it has been erected. The completed elbow appears like that shown in the article referred to above.

The base for an internal bend may be cut for a 90-deg. turn, as shown in Fig. 2. In Fig. 3*A* the base, which has been cut as outlined in Fig. 2, is shown in position in the corner, ready to receive the capping, and at *B* it is shown with the capping in position. It will be noticed that it is not necessary to miter the capping, as it completely incloses the slot in the base if pushed into the corner as suggested at Fig. 3*B*.

For an external bend the base is cut with a hacksaw, as shown at *A* (Fig. 4), and is then bent and secured on the corner as outlined at *B*. The capping for an external bend should be mitered as detailed at *C*. When this is done there may be a small hole just at the apex of the angle included within the molding, as shown in the illustration, but this is of no consequence.

Fewer screws are required for the erection of metal molding where "conducting-pieces" are used. Where "conducting-pieces" are used two screws or bolts are required at each turn or elbow to maintain the electrical continuity of the run. Where molding (as herein outlined) is electrically continuous it can often be well supported by screws inserted through the holes punched in the base by its manufacturers. Where this is done the extra labor of drilling additional screw holes and of driving the extra screws is avoided.

INCANDESCENT STREET LIGHTING IN WARREN, OHIO.

BY A. E. LENNOX.

The illumination of the streets of Warren, Ohio, a city of approximately 12,000 inhabitants, furnishes a notable example of a municipality made cheerful and attractive through the efforts of its citizens to secure modern and effective street illumination. The new street lighting in Warren had its beginning two years ago when the contract with the Warren Water & Light Company for street lighting was about to expire. Up to that time the city depended on an open-arc lighting system in which the units, located principally at street intersections, afforded but meager illumination at points removed from the immediate vicinity of the lamps.

The Board of Public Service first directed its attention to the advisability of substituting inclosed arcs for the units then in use, but it was afterward realized that the question of effective light distribution would be still an unsolved problem. When, therefore, an incandescent system was suggested it receive very careful consideration by those who were directly in charge of the matter. It was at this stage that the Warren Water & Light Company was induced to co-operate in the installation of a trial system of tungsten lamps on Park Avenue, in which a staggered arrangement of series lamps was adopted. A little later a second trial demonstration was made with a straight-line arrangement of units on Mahoning Avenue. Both of these installations proved so satisfactory that the citizens were unanimous in their approval of incandescent lighting. All thoughts of having an inclosed-arc lighting system were finally abandoned and specifications were drawn up for lighting with street series tungsten lamps. The Warren Water & Light Company was awarded a contract to cover a period of ten years, during which time, in addition to installing the system, it was to be responsible for its complete operation.

The installation, which is now completed, is divided naturally into two parts, viz., the residential and the downtown systems. In the former there are 355, 90 and 175 6.6-amp street series Mazda lamps of 40, 60 and 80 cp respectively. All the units are equipped with Wheeler radio reflectors and are suspended by gooseneck brackets from wooden poles arranged in a straight line along one side of each residential street. In the spacing of these units one lamp is located at each street intersection and the intervening distance between corner lamps is divided so that the spacing is as uniform as possible. This varies, however, from 100 to 300 ft. on the different streets, depending on the traffic demands and to some extent on the foliage of the shade trees. The height of the lamps above the pavement is 14 ft. and they are suspended 3 ft. beyond the curb line over the road. The illumination in the residential districts is highly satisfactory and is far superior to that furnished by the former open arcs.

Fig. 1—Day View of Mahoning Avenue.

The ornamental lighting of the downtown streets is quite spectacular. Sixty-two three-lamp iron standards supporting two pendent lamps and one upright are employed on the principal business streets, while around the centrally located park 22 single-lamp standards are located. At the entrance of the courthouse, on the north side of the park, two five-lamp standards are situated, one on either side of the approach. All upright lamps are rated at 80-cp, except nineteen 60-cp lamps on the single-lamp standards, and are sur-

rounded by 14-in. Alba globes, while 12-in. globes are used on the 40-cp pendent lamps. The spacing of the three-lamp standards is uniform on each street, but varies from 65 to 75 ft. on different streets; that of the single-lamp standards is from 65 to 85 ft. The corner standards at street inter-

Fig. 2—Day View of Market Street.

sections are set where the street lines extended meet the curb line; thus there are eight of these standards at each intersection.

The ornamental standards were supplied by the Canton Metal Post Company, Canton, Ohio. Each standard is anchored to a 2½-ft. cube of concrete, the center of which is placed 18 in. back from the curb line on the business streets, thus allowing the outside pendent lamp to be hung directly above the face of the curb.

The wiring of the standards is all underground. Where it was necessary to place this under pavement, fiber conduit with 4550 ft. of lead cable was incased in concrete beneath the gutter close to the curb and beneath the street foundation. In park lighting or where lawns were available 3065 ft. of steel-armored cable was placed from 2½ ft. to 3 ft. back of the curb under the lawn. For all underground work No. 8 wire was employed, and No. 6 for over-

Fig. 3—Three-Lamp Standard.

head wiring in the residential streets. Since the power station is quite centrally located, no feeder systems are used, but the several circuits on which lamps are operated are controlled from the power house.

An all-night schedule has been adopted for lamps on the residential streets, since it was thought more economical to operate the lamps all night than to duplicate the extensive wiring system necessary throughout this part of the city. In the case of the ornamental system, however, the upright lamps only burn on all-night schedule, while pendent lamps

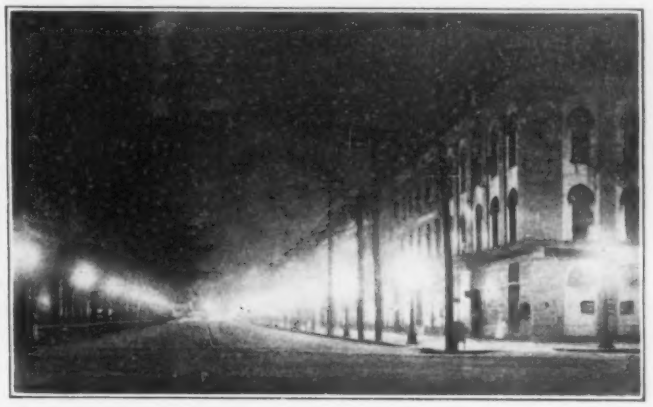


Fig. 4—Night View of Market Street.

are switched off from the power station every night at midnight.

On account of the short time since the system has been in operation, it is impossible to give a full report on the operating expenses. The contract specifies the following prices which must be paid to the lighting company for maintaining the three sizes of lamps in the two systems and under the two operating schedules. The cost of installation is taken care of in these prices:

SCHEDULE OF RATES FOR INCANDESCENT STREET LIGHTING.

Size of Lamp.	Ornamental.		Residential.
	All Night.	Midnight.	All Night.
40 cp	.....	$12.00	$13.50
60 "	$19.50	14.50	19.50
80 "	23.00	18.00	23.00

Included in the cost of installation, that of the standards, bases, conduits and wire was as follows: Five-lamp standards, $40; three-lamp standards, $36.50; one-lamp standards, $30. These figures are based on one standard of each kind exclusive of lamps, globes, sockets, etc. The 3065 ft. of steel-armored cable cost 36 cents per foot and an additional 5 cents per foot for laying. The lead cable, of which there was 4550 ft., cost 21½ cents per foot, and the bases for the 86 posts were estimated at $3.50 each. The fiber conduit laid cost 51 cents per foot, and the cost of the globes, when freight charges, crating, etc., were paid, was approximately $1 each. Warren is well known as a lamp-manufacturing town and the lamps for the entire system were supplied by one of the prominent lamp companies there.

In the old open-arc lighting system there were 161 units, consuming 500 watts each and operating on 9.6 amp. Seventy-one of these lamps burned on all-night schedule and the remainder till midnight, in the former case the city paying the central station $80 each per annum, and in the latter $55 each a year. It must be understood, however, that the relative operating costs of the arc and incandescent systems are no criterion by which the efficiency of the two should be judged, since the new system covers a much larger terrtiory and also because the lighting conditions have been greatly improved. The spacing of the units and the locations of the ornamental standards have been taken care of by the local city engineer, Mr. Bert C. Smith.

RECENT TELEPHONE PATENTS.

SWITCHBOARD CIRCUIT.

There has been issued to Mr. H. P. Claussen, of Chicago, a patent describing an arrangement of switchboard circuits providing means for connecting battery and magneto-signal lines. Local battery is contemplated for the transmitters at all stations. When dissimilar lines are to be connected a key is operated which inserts a repeating coil in the cord circuit. This permits talking connection but isolates the signaling currents. The patent is assigned to the Stromberg-Carlson Telephone Company.

SELECTIVE PARTY SYSTEM.

Two patents have been granted to Mr. W. M. Bruce, Jr., of Springfield, Ohio, covering a lockout selective system and the apparatus therefor. The apparatus is controlled by impulses sent out upon one or the other side of the line, or both. A vertical bar is arranged to be lifted a step at a time by impulses upon one side of the line. The bars at all stations move synchronously. Each step corresponds to the selective position at one station, and if an impulse be sent upon the other side of the line, the current finds a path through a connecting magnet at that particular station, the various connecting magnet circuits being controlled by the bar. An impulse over both sides of the line simultaneously operates the trip magnets and restores all stations to normal. These patents are assigned to the American Automatic Telephone Company.

REPEATING SYSTEM.

The repeating apparatus patented by Mr. C. G. Ashley, of Chicago, was noted in this column a few weeks since. There has now been issued to him a patent for his "method of propagating telephonic currents." The received current is led into a unipolar generator and there impressed upon the otherwise uniform field in which the conductor is spinning. A reinforced telephone current is set up by the generator.

RECEIVER SUPPORT.

The patent granted to Mr. C. E. Flynn, of Vale, Ore., relates to a receiver holder. The holder proper consists of a bar with a supporting clamp which maintains the receiver in suitable position for use. The bar in turn is mounted upon a sliding sleeve surrounding the stem of a desk stand. The sleeve holds the hook switch lever down, save when grasped in the hand of the user as though to lift the instrument. A latch is provided to release the hook lever in case it becomes inconvenient to continue the lifting effort.

EXCHANGE CIRCUITS.

At times it becomes necessary to operate a hybrid exchange system employing signal lamps operated upon a central-office battery but employing subscriber station equipment equipped with a magneto-generator and for a local transmitter battery. To such a system an invention of Mr. H. P. Claussen applies. Instead of the usual line relay he provides a self-locking relay sensitive to alternating ringing current. A condenser is inserted in one limb of the line. A turn of the magnet crank pulls up the line relay and closes the signal-lamp circuit. The resulting current locks up the relay until cut out by the cut-off relay. This latter responds to the insertion of a plug in the answering jack. The patent for this system is assigned to the Stromberg-Carlson Company.

SELECTOR MAGNET.

An improved electromagnet for a selector has been patented by W. Kaisling, of Chicago, and assigned to the Kellogg Switchboard & Supply Company. The core proper is mounted within a U-shaped return pole piece. The armature hangs from the upper leg of the U and confronts the core and lower leg of the U. The upper leg of the U has a wide notch cut in its end to receive the armature and a pin is inserted so that a hinge is formed. The pin moves freely in the perforations in the pole piece, but is clamped in a groove in the armature.

LETTERS TO THE EDITOR.

Transmission-Line Supports at Different Elevations.

To the Editor of Electrical World:

Sir:—I have read with interest Mr. J. S. Viehe's article in your issue of June 15 regarding transmission-line supports at different elevations. Allow me to call to your attention that this method was described by Mr. Torsten Holmgren, of Trollhättan, Sweden, in *Teknisk Tidskrift, Elektroteknik*, No. 3, 1910, and in *Mitteilungen den Vereinigung der Elektricitätswerke*, Heft 9, 1910. Prior to this date it was used in the construction of the transmission line between Trollhättan and Gothenburg, which was designed and built by Mr. Holmgren.

New York. Kaj Lindholm.

To the Editor of Electrical World:

Sir:—In the interesting paper by Mr. J. S. Viehe on "Transmission-Line Supports at Different Elevations" in the *Electrical World* for June 15, 1911, I note that he apparently deals with the center line of the transmission line. It should be noted as a practical and an extremely important fact that not only does it sometimes happen that the least clearance is not at the lowest point of wire, but that in side hill work ample clearance on the center line may not give suitable clearance on the up-hill side wire, this being particularly true on two-circuit lines and on lines having wide phase spacing. In laying out a tower line it is, in many cases, absolutely essential to have profiles under the two extreme side wires, and it is always advisable to have the layout checked in the field before actual construction begins.

New York. Charles Rufus Hart.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Three-Phase Commutator Generator.—R. Rüdenberg.—If a three-phase commutator machine in which the stator circuit and the rotor circuit are connected together is mechanically driven, experiment shows that under certain conditions a magnetic field is produced which rotates with a certain speed. The author has formerly given the theory of such a generator under simplified assumptions and gives now the theory on more general and more accurate assumptions when the machine is running unloaded. He shows that the self-excitation of the machine is not influenced by the stray field of the machine, while the frequency of the alternating current produced is only slightly influenced. Simple circular diagrams are given.—*Elek. Zeit.*, May 18.

Induction Motors.—J. Rezelman.—A continuation of his serial dealing with the reactance of induction motors with squirrel-cage rotors. The leakage reactance of a two-pole 50-hp induction motor is analyzed. The rotor winding is found to exert no magnetizing effect upon the end coils of the stator winding. The losses on short-circuit are determined for various frequencies.—Lond. *Electrician*, June 2.

Lamps and Lighting.

Discrimination of Colors.—F. W. Edridge-Green.—A paper presented before the Royal Society in London. If

a definite portion of the spectrum be isolated it appears monochromatic, the size of the monochromatic region varying with the luminosity and wave-length of the light and the color perception of the observer. Lord Rayleigh had expressed the opinion that he could discriminate between the colors in a monochromatic region even to the extent of distinguishing between the colors of the two *D* lines. The author, however, did not find this possible when special precaution was taken to have a pure spectrum and to avoid the physiological effect of contrast through varying intensities of the areas to be compared. The monochromatic area may be magnified without altering its monochromatic appearance, the intensity of the light source being increased to compensate for the diminished luminosity. The monochromatic area may also be examined through a double-image prism, or be projected by means of a double-image prism upon a screen, so that the violet side of one area would be adjacent to and just touch the red side of the other area. In this way the monochromatic area may be made as large as desired, the intensity of the source of light being increased as required. An arc lamp gives two very bright areas of color. This method is the most favorable for the detection of any difference; the monochromatic areas, however, still remain monochromatic.—Lond. *Electrician,* June 2.

Factory Lighting.—C. E. CLEWELL.—The author discusses the relation of factory-lighting problems to efficient management and classifies the different problems in factory lighting. Reflectors for uniform illumination are discussed and an account is given of a recent typical factory-lighting installation where tungsten lamps are used. The 100-watt lamps seemed the best average size, but at least two intensities were found advisable, one somewhat high for detail and machine work and a lower intensity for general assembly work. Of the various mounting heights tried it was found very desirable to mount the lamps as close to the ceiling as possible, so that glare was reduced to a minimum. While the ratio of spacing distance to mounting height of the lamps called for a concentrating reflector for producing uniform downward light, a distributing reflector was essential for the purpose of providing the necessary side light. An intensity of about 2 ft.-candles on the sides of the machines seemed to be sufficient. Bowl-frosted lamps proved not so desirable as clear lamps, due to the more rapid effect of dust and dirt on the frosting than on clear glass. The effect is, of course, particularly noticeable in factory work. Metallic reflectors were far inferior to glass because of the fact that no light passes through them. Glass reflectors, on the other hand, permit some of the light to pass through the reflectors and to be in turn reflected from the light ceiling and walls. Lamps without reflectors were debarred on account of the glare which resulted when a man looked up from his work. Moreover, since 62 per cent more light on the working surface was produced by lamps equipped with reflectors than with lamps of the same size alone, it was considered a doubly good investment to provide all lamps with reflectors.—*Elec. Jour.,* June.

Street Lighting.—L. CROUCH.—A continuation of his illustrated serial on electric street lighting. The author compares the luminous efficiency of various incandescent and arc lamps and then gives polar candle-power distribution curves for arc lamps. He further gives spherical reduction factors for various lamps and compares the intrinsic brightness of various sources. He then takes up the discussion of Nernst lamps for street lighting.—Lond. *Elec. Review,* June 9.

Lighting of Small Offices.—C. E. CLEWELL.—The author discusses the lighting of small offices under the following heads: Elimination of drop lamps, range of the number of lamps for each office, first cost as a factor, spacing distance of lamps, sizes of lamps available, lighting calculations.—*Elec. Jour.,* June.

Generation, Transmission and Distribution.

Test of Turbo-Alternator.—Results of the tests of one of the new 5000-kw steam turbo-alternators built for a British company. The turbines are of Westinghouse latest impulse type and are arranged to use high-pressure steam at 175 lb. per square inch pressure and 150 deg. Fahr. superheat, both measured at the stop valve. The conditions specified for carrying out the tests were as follows:

Normal output 5,000 kw, three-phase, 25 cycles, 11,000 volts.

25 per cent. overload for	6 hours
Full load for	6 hours
Three-quarter load for	2 hours
Half load for	2 hours
Quarter load for	2 hours

The results of the tests are as follows:

Output in kilowatts	1,346	2,715	3,902	5,066	6,487.5
Speed, r. p. m.	1,500	1,500	1,500	1,500	1,500
Steam pressure, lb.	174	176	175	174.5	174.5
Steam temperature, deg. Fahr.	518	519	542	552	544
Steam superheat, deg. Fahr.	141	141	164	175	167
Vacuum corrected to 30-in. bar.	28.13	28.28	28.58	28.68	28.53
Cir. water inlet temp., deg Fahr.	43.9	43.7	44.0	44.0	43
Cir. water outlet temp., deg. Fahr.	48.0	52.6	57.0	60.0	65.5
Total steam consumption, lb.	24,780	40,130	53,125	65,860	85,880
Steam con., lb. per kw-hour	18.14	14.78	13.61	13.00	13.24

—Lond. *Electrician,* June 2.

Electric Driving of Rolling Mills.—G. J. HOOGHWINKEL AND F. THURSFIELD.—A paper read before the Staffordshire Iron and Steel Institute on the electric driving of light rolling mills. This is an easy problem as compared with heavy reversible mills, since there is no high installation cost and no complicated equalizing plant. The authors point out that from the electric drive of a rolling mill an increased output is obtained as a matter of experience. This is due to two causes—(a) the more even turning moment, resulting in fewer hot bearings, breaking of couplings, etc., and (b) the more uniform speed, permitting the average speed to approach more nearly to the maximum. Both these causes favorably influence the quality of material produced. The different possibilities of the source of power supply are discussed with special reference to the utilization of the low-pressure steam from the puddling furnaces in steam turbines coupled to electric generators, enabling the larger works to produce their own electric energy required for the rolling mills and auxiliary plant. A list of electrical driving mills is given.—Lond. *Electrician,* June 9.

Pumping.—R. H. WILLIS.—A paper dealing in some detail with the use of turbine pumps in collieries, with an account of the discussion which followed the paper before the Association of Mining Electrical Engineers.—Lond. *Electrician,* June 9.

Electric Plows.—K. SIMONS.—An illustrated article in which the author critically reviews the present constructions of electric plows. He does not think that any of those now available fulfils all requirements and emphasizes that the problem of electric plowing should be considered from the viewpoint of the farmer rather than of the electrical engineer.—*Elek. Zeit.,* May 11.

Traction.

Electric Traction on German Railways.—The Prussian Parliament has been asked to grant about $7,000,000 for an extension of the electric railway from Dessau to Bitterfeld and for the erection of a new electric railway in the Silesian mountain district.—*Elek. Zeit.,* May 11.

Electric Traction in Lapland.—A note on the progress of electrification of the Lapland Railway. In spite of an unusually severe Arctic winter, with a tremendous downfall of snow, the work on the Porjus Railway has been energetically proceeded with and the work in connection with the hydroelectric station at Porjus has been commenced. The construction of the power line from Porjus will be taken in hand this month, and part of the line is expected to be finished before the end of the year. The present large steam locomotives haul, as a rule, twenty-eight cars, each with a load of 30 tons. The electric trains will comprise forty cars of the same size, propelled by two electric locomotives, one pulling and one pushing, with an aggregate rating of some 2000 hp, and the average speed will be

about twice that of the present trains. The increased speed will make it possible to dispatch twelve trains in the day instead of the present nine trains, without increasing the number of passing places. The experimental trains had the same weight as the future electric trains—that is, forty cars—but they were each hauled by two locomotives. Negotiations have also been entered into with the Norwegian railway authorities about a possible electrification of the Norwegian section of the line from Riksgransen to Narvik. —Lond. *Eng'ing,* June 9.

Installations, Systems and Appliances.

Rates.—H. Passavant.—The author emphasizes that a uniform rate should be devised covering the supply of electricity for all different purposes. This should be based on the cost of producing the electric energy in the central station. If the fixed costs are assumed to be $68.75 per kilowatt and the cost of operation 1 cent per kw-hour, then the yearly cost of 1 kw is $6875 + N$ cents, where N is the number of hours use for the year during which the electric energy is used. For different numbers of hours for which the energy is used the prices of the yearly kilowatt and the average price of the kw-hour are given in the following table in dollars and cents respectively:

Hours per Year.	Price per Kw per Year. Dollars.	Price per Kw-hour. Cents.
500	73.75	14.75
1,000	78.75	7.88
2,000	88.75	4.45
3,000	98.75	3.3
4,000	108.75	2.73
5,000	118.75	2.38
6,000	128.75	2.15
7,000	138.75	1.98
8,000	148.75	1.85

In selling energy to small consumers it hardly pays to install a meter and in such cases a flat rate is allowed, assuming that the equipment installed is used for a certain number of hours per year. However, this number of hours is often assumed too low. As a matter of fact, the most intelligent consumers will try to use their connections all the time to the fullest extent. When they are not needed for lighting they will use them for heating water and cooking. This principle has been developed in the most logical way in an article in the *Electrical World,* 1911, Vol. 57, page 45, in conection with the system of the Hartford Electric Lighting Company. Since a consumer will hardly use the connections for all the 8760 hours in the year the author bases his calculations on the assumption of 8000 hours per year and recommends to charge according to the above table for a consumer with connections of 100 watts $15 per year. This gives him three metallic-filament lamps of 25 cp and permits him to prepare all the cooking for three or four persons. If a consumer has connections of 300 watts the yearly charge is $45. This gives him ten metallic-filament lamps of 25 cp and permits him to do all the cooking and water heating. The author proposes to make this the basis of his uniform rate. The fundamental point is not to charge for kw-hours, but for kilowatts, and to encourage as much as possible the fullest utilization of the installation. If $150 is the charge for the yearly kilowatts, the average price of the kw-hours in cents will vary as follows with the number of hours of use:

Hours per year.....	500	1,000	2,000	3,000	4,000	5,000	6,000	8,000
Cents per kw-hour...	30	15	7.5	5	3.75	3	2.5	1.9

This is a fair rate also for the lighting of restaurants. For instance, he assumes for restaurants which are open during the night that the number of hours of lighting are 3000; according to the above table the kw-hour will cost 5 cents, which is less than the usual rate. In pure lighting installations limiting devices should be used to prevent the consumer from consuming more power than contracted for. This could not be done when electricity is used for motor purposes. In this case he recommends metering the excess kw-hours only. In the most general form the rate would therefore be as follows: Electricity is furnished to the consumer on the basis of the kilowatts contracted for at a yearly price of $150 per kilowatt; if more than the power contracted for is used the excess of the energy in kw-hours is charged for at the price of 10 cents per kw-hour. The exact figures may be varied according to the first cost of the station and the cost of raw materials used in operation, but the principle would be the same in all cases and the author thinks that the rate based on this principle would not only make electricity more popular with all kinds of consumers, but would considerably increase the load-factor of the station.—*Elek. Zeit.,* May 11.

Wires, Wiring and Conduits.

High-Tension Cables.—L. Lichtenstein.—An English translation of his recent German paper on the present state and future prospects of high-tension cable manufacture.—Lond. *Electrician,* June 2.

Tension and Sag in Wires.—E. Parry.—An article on the determination of tension and sag in overhead wires, giving useful formulas and tables.—Lond. *Elec. Eng'ing,* June 8.

Electrophysics and Magnetism.

Valency in Gaseous Ionization.—R. A. Millikan and H. Fletcher.—The authors studied the act of gaseous ionization through the capture upon oil drops of the products of the ionization. The authors used various methods of producing ionization, namely, primary Röntgen rays, secondary Röntgen rays and the beta and gamma rays of radium. Although the authors entered upon this investigation with the expectation of proving the existence of valency in gaseous ionization, they have instead obtained direct, unmistakable evidence that the act of ionization of air molecules by both primary and secondary Röntgen rays of widely varying degrees of hardness, as well as by beta and gamma rays, uniformly consists, under all conditions which they have been able to investigate, in the detachment from a neutral molecule of one single elementary electrical charge.—*Phil. Mag.,* June.

Radium Emanation,—R. W. Boyle.—An account of experiments on the behavior of radium emanation at low temperatures. The author studied by a new method the process of volatilization of condensed radium emanation at low temperatures.—*Phil. Mag.,* June.

Units, Measurements and Instruments.

Magnetization Curves of Iron.—J. T. Morris and T. L. Langford.—An abstract of a paper read before the Physical Society in London. The authors investigated the differences existing between the magnetization curves for a given sample of iron when determined (1) by the older methods in which the flux is changed suddenly, (2) by a method in which it is changed exceedingly slowly and at a uniform rate. The methods experimentally examined were: 1—Method of constant rate of change of flux. 2—"Slow cyclic" hysteresis loops by method (1). 3—"Step-by-step" magnetization curve. 4—"Step-by-step" hysteresis loops. 5—Method of reversal. 6—Alternating-current magnetization curve. Details are given of the theory and practical working of method (1). In this method the magnetizing current is continuously increased through a primary winding by a specially designed resistance at such a varying rate as to maintain a constant voltage generated in a secondary winding. A certain amount of skill is required in operating the resistance, but an average experimenter may easily acquire this with a little practice. The time required for a complete change of the current varied from one up to five minutes. Tables are given of the magnetization curve determined by the six different methods at a number of values from $H = 0.3$ up to 70, and of the permeability from $B = 500$ up to 17,000. At low values of the magnetizing force the uniformly varying flux method gives results of some 200 lines per square centimeter in excess of the older methods. As regards the time required for determinations by the various methods experimentally examined, ballistic methods are undoubtedly the most tedious. The alternating-current method (method 6) has considerable advantages in this respect, a full set of readings of magnetizing current

and induced voltage occupying a very short time. When, however, it is necessary to take oscillograms at various points in order to plot curves of form-factors, the time required is enormously increased. The method of uniformly varying flux (method 1) is peculiarly adapted for use where time is a consideration and a high degree of accuracy is desired. A complete magnetization curve may be taken in a very few minutes, and the mean of many such curves obtained in, say, one hour, the iron being demagnetized between each test. The method of "uniformly varying flux" appears to possess advantages, both scientific and practical, over the older methods in use for testing of ring samples of magnetic materials. It avoids difficulties due to eddy currents and magnetic viscosity, which effects are themselves due primarily to rapid or irregular changes of flux. Besides rapidity of experiment it also has the advantage of accuracy of repetition under standard or predetermined conditions of magnetic change. The method is, therefore, commended for the carrying out of magnetic tests, especially where great accuracy under definitely known conditions of experiment is essential.—Lond. *Electrician*, May 26.

Electric Thermoregulator.—H. L. CALLENDAR.—At a recent meeting of the Physical Society in London the author gave a demonstration of the action of the thermoregulator designed by him in 1897 for experiments by the continuous electric method on the specific heat of water. The expansion of liquid in a bulb causes a thread of mercury to make contact with a platinum wire actuating a relay which puts a 16-cp lamp in series with a 32-cp lamp in the regulator tank. If the wire is fixed, hunting occurs owing to the mercury sticking to the wire and to lag of the regulator bulb. This is prevented either by causing the wire to move up and down continually through a distance of about 1 mm with a period of 5 to 10 seconds or by fixing the lamp bulb close to the regulator bulb. The hunting was demonstrated by means of a platinum thermometer reading to 0.001 deg. C. Other details of construction were also explained. The same type of regulator is now being employed for measurements of the variation of the specific heat of water by a new method in which two steady currents at different temperatures are allowed to mix, or share their heat, the resulting temperature being observed.—Lond. *Electrician*, May 26.

Measurement of Logarithmic Decrement of an Oscillation Circuit.—A. PETROWSKI.—The measurement of the logarithmic decrement of a circuit by the resonance method gives in reality the sum of two logarithmic decrements, namely, that of the oscillating circuit under test and that of the wave meter which is used for measurement. It is, therefore, necessary to know the latter. The author shows that the simplest way to overcome all difficulties is to use two wave meters and make three measurements whereby the logarithmic decrements of the two wave meters can be easily eliminated.—*La Lumière Elec.*, May 20.

Telegraphy, Telephony and Signals.

Wireless Telegraphy for Time Signals.—M. TISSOT.—The author first deals with the experiments made in Paris to utilize the Eiffel Tower wireless telegraph station for the transmission of time signals. The trials consisted in obtaining by the aid of "dots" sent from the tower the comparison of chronometers of known rates, placed at each of these stations. Very concordant values were obtained, agreeing to 0.5 second—an approximation amply sufficient for ships. As a result of these experiments a service of regular time signals was commenced in May, 1910. The signal consists of a "dot" emitted at midnight—Paris mean time—preceded by a *call* signal. This is repeated at two minutes and four minutes past midnight. The emission from the tower necessitates the making and breaking of a current of 50 amp by means of a device actuated by a relay controlled by the observatory. This is done by a mercury-jet interrupter designed by Ferrie. A small turbine forces mercury under pressure through a tube pivoted on a horizontal axis O (Fig. 1). By means of a spring R this tube is normally directed toward the fixed part N of the turbine. On closing the key K a current in the coil E attracts a plunger causing the tube to turn so that the stream of mercury impinges on an amalgamated copper disk keyed to the

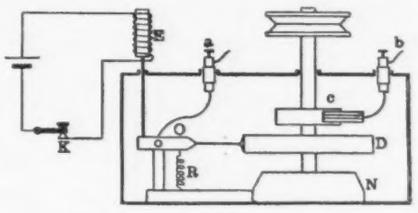


Fig. 1—Mercury-Jet Interrupter.

axis of the turbine. The main circuit is thus closed through the mercury jet. On opening K the jet falls and the current is broken without the production of an arc. To secure a quick break it should be produced in a liquid dielectric by filling the turbine with paraffin or alcohol. A simple receiver suitable for small ships consists of a Oudin resonator (Fig. 2) of rectangular form, the secondary of which is fixed and constitutes, with a condenser C, also invariable, a resonating circuit, tuned once for all to the period of the waves emitted from the Eiffel Tower. A detector is inserted in this circuit with a telephone across its terminals. The primary is inserted between the antenna and the earth and consists of the part of this solenoid between M and the sliding contact A. This sliding contact is moved until the sound in the telephone is a maximum. The detector, which is of the solid-contact type and requires no auxiliary battery, consists of a fixed electrode, which is a small piece of sulphide of copper or galena, and an adjustable electrode consisting of a fragment of zinc oxide, the whole being inclosed in a protecting brass cylinder. The observation of a single "dot" is not sufficient to fix the precise value of a difference of longitude. In order to use the method of coincidence a series of periodic signals is necessary. For this purpose Claude has adapted the Lippmann pendulum, electromagnetically maintained, in the following manner. Two silver-wire circles a and b (Fig. 3) are fixed to supports m and n, and are inserted in the circuit containing the cell P and relay R. A small piece of silver carried by the pendulum closes the circuit as the pendulum passes through the vertical. The duration of contact is long enough to secure the working of the relay; this can be regulated by micrometer screws which allow the

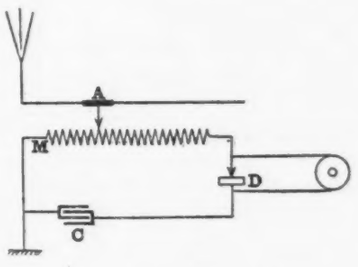


Fig. 2—Oudin Resonator.

supports m and n to be displaced. At each beat of the pendulum the relay is actuated and closes the circuit E (Fig. 1) so that a spark is produced. The successive beats thus give rise in the receiving telephone to a series of ticks. It is then easy to compare two pendulums placed at any two stations, A and B, by using as intermediary a pendulum at a third station C. In order to apply the method of coin-

cidence the length of the pendulum at *C* is adjusted so that its time of vibration is slightly greater than that of either of the pendulums to be compared. This method has been applied to the determination of the difference of longitude between Paris and Brest, the pendulum *C* being at the Eiffel Tower, *A* and *B* at the observatory at Montsouris and the radiotelegraphic station at Brest respectively. By the

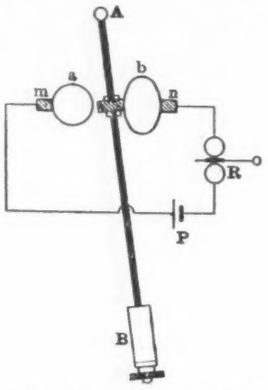


Fig. 3—Lippmann Pendulum.

aid of a microphone the beats of a local chronometer were observed in the receiving telephone, together with the signals from *C*. The microphone is inserted in the primary of an induction coil, the secondary of which is connected to the receiving telephone. Adjustable resistances in both the primary and the secondary make it possible to equalize the intensity of the beats from the chronometer with that of the signals transmitted by wireless telegraphy.—Lond. *Electrician,* June 9.

Telephone Meter.—A note on a recent British patent (11,048, June 1, 1911) of A. J. Boult (International Telechronometer Company, New York). This invention provides a metering apparatus which is installed at a telephone subscriber's station (in conjunction with the telephone set) to register the number of calls and also the length of time the call takes. Each of the mechanisms comprises an operating electromagnet. A normally open-shunt circuit round the electromagnet, which can be closed by contacts under control, is arranged to remove the impedance of the operation from the circuit. For recording a number of messages and also the length of time the line is in use, the operating electromagnet and the shunt-controlling magnet are oppositely polarized so that one responds to current flowing in one direction and the other magnet responds only to current in the opposite direction. Two circuits are provided for impressing currents of opposite polarity on the subscriber's circuit with the necessary arrangement whereby the message meter and the time-recording device are not operated until the call has been answered by the removal of the receiver, when the circuit is complete.—Lond. *Elec. Eng'ing,* June 8.

Automatic Telephony.—W. Aitken.—A paper read before the (British) Institution of Electrical Engineers on automatic-telephone exchanges. He dealt with the subject in considerable detail, and expressed himself strongly in favor of the automatic switchboard, quoting American results to show its efficacy and economy. In the discussion J. E. Kingsbury, F. Gill and M. S. Connor all considered that sufficient cause had not been shown for the abandonment of the manual board in favor of the automatic. A. W. Whalley, however, thought that, whatever the expense, the saving in time in obtaining connections and clearing should justify the erection of an automatic-exchange system in London, and R. Scruby related the favorable impression he had obtained from his examination of automatic exchanges in America. In the first part of his paper Aitken also described the recent adoption of keyless ringing on the incoming junction boards of the ordinary common-battery exchanges, and explained an arrangement for automatic clearing which the British Insulated & Helsby Cables have recently introduced for private-branch exchanges too small to have a regular operator.—Lond. *Elec. Eng'ing,* May 25.

Miscellaneous.

Electric Cooking.—An article on special electric-cooking demonstrations recently held at the showrooms of the Hampstead municipal electric station in London. A description is given of the particular electric ovens used, and it is pointed out that a great feature of electric cooking in addition to the improved flavor of the food is the considerable saving in meat. The following comparative figures are given as results of tests with an electric oven and a coal range. The joint was a top side of beef.

	Coal.	Electric.
Weight uncooked	5 lb. 4 oz.	4 lb. 0 oz.
Weight cooked	3 lb. 6 oz.	3 lb. 8 oz.
Loss in cooking, per cent	35.7	11.5

This indicates that with electric cooking a 4-lb. joint is equivalent to a 4.25-lb. joint where an ordinary oven is used.—Lond. *Electrician,* June 9.

Danger of Fire.—A comparison is made of the danger of fire from electricity, gas and kerosene, with statistical data on the causes of fires in 1908 in Germany. The conclusion is drawn that the electric light is the safest of all methods of lighting.—*Elek. Zeit.,* May 11.

Book Reviews.

The Steel Workers. By John A. Fitch. New York: Charities Publication Committee. 380 pages, illus. Price, $1.50.

Virtually a report to the Russell Sage Foundation concerning the social, economic and industrial conditions of the steel workers in the mills of Allegheny County, Pa. There is much information in the book of a character that bespeaks care and earnestness in its collection. Nevertheless the book seems to carry a brief as well as evidence. The force of the evidence would be greater if the brief were omitted or relegated to a separate section.

Homestead. By Margaret F. Byington. New York: Charities Publication Committee. 292 pages, illus. Price, $1.50.

Virtually a report of nearly 300 printed pages, with photographs, from a social-service worker to the Russell Sage Foundation, concerning the households, lives, habits, economics and social status of the workers in the steel mills at Homestead, Pa. The book is one of a series of six volumes entitled "The Pittsburgh Survey." The book is well printed and prepared. It seems to be written in a fair and truthful attitude of mind. There is a large mass of material presented, and much that is satisfactory appears hand-in-hand with what might be better amended.

Engineering Chemistry. By Thomas B. Stillman. Fourth edition. Easton, Pa.: Chemical Publishing Company. 744 pages, 174 illus. Price, $5.

The fourth edition of an excellent and carefully prepared textbook and reference book on engineering chemistry. It deals mainly with the chemistry of fuels, solid, liquid and gaseous. The illustrations of apparatus are very good and the description is clear. Much of the chemical computation is in the metric system, but, unfortunately, the pages are marred by constant bewildering reference to English units. We hope these will be largely cut out in subsequent editions, as metric methods are far the simplest and safest for the engineer. The book will be of great value to all engineers who deal with fuels and have occasion to analyze them without being chemists.

ELEMENTI DI METALLURGIA. By Alfonso Greco. Leghorn: Raffaello Guisti. 192 pages, 27 illus.

A pocket textbook on a particular branch of metallurgy, namely, the furnace production of iron and steel. Commencing with a brief historical statement concerning the development of iron and steel in civilization, the author proceeds to discuss the production of pig iron, the nature of the operations taking place in the blast furnace, the production of steel by various methods, the theory and practice of tempering steels and the classification of steels and makes a very brief reference to electric-furnace steel. The book is a handy pocket guide to industrial processes for the furnace production of steels and will be found useful by metallurgical students and others.

New Apparatus and Appliances

PACKING GOODS FOR EXPORT.

BY A. C. JEWETT.

This article has to do with the poor packing, and insufficient and illegible marking on cases, of American machinery exported abroad, and with the bad advertising it gives to American machinery and appliances, due to consequent loss and damage during transport.

In addition to this, the customer is often put to any amount of annoyance, and expensive delays are caused by the failure of the exporter to follow shipping instructions and to supply the requisite number of negotiable and non-negotiable bills of lading, together with priced and detailed memoranda of shipments often required by foreign governments for statistical and customs purposes and which must be supplied before the customs will release consignments.

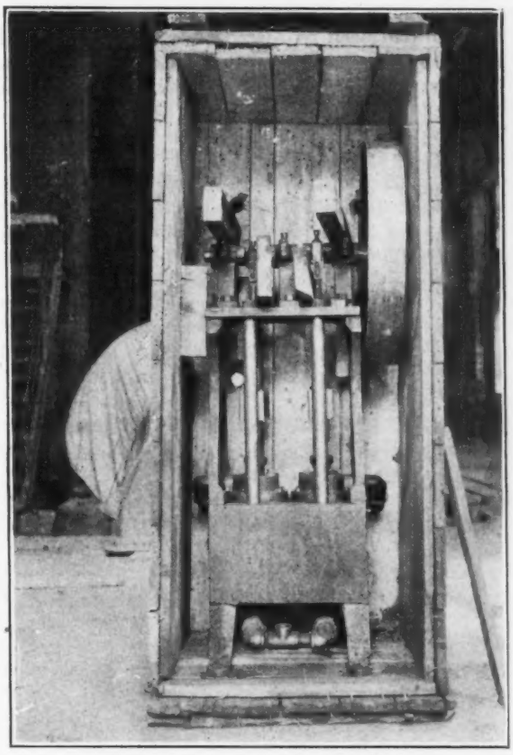


Fig. 1—Packing Showing Unnecessary Space at Top.

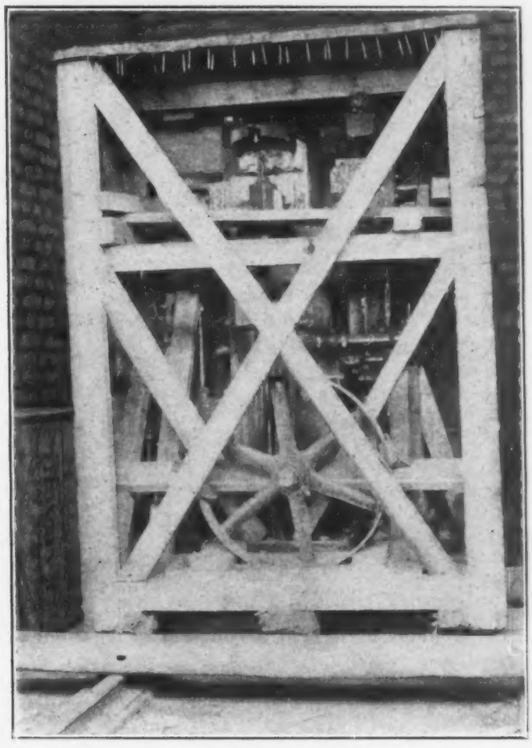


Fig. 2—Properly Packed Case.

The head of a department in a large American firm which does a considerable export business was heard to say recently: "Our foreign business is made a football of. When our factories are full with work here at home and times are good we neglect it. When times are dull and there is not enough to keep us going at home we go after foreign business again, but it cannot be continually dropped and picked up," which is quite true. Some day we may want it very much and find it has gone elsewhere. The Germans and others keep what they get and they are always after more; also they study the requirements of their foreign trade and conform to them.

The writer has been abroad since 1900 on construction work in Asia and South America, and has handled electrical, hydraulic and mining machinery—American, English and German—principally American electrical apparatus, and has had considerable experience with and opportunity to observe cause and effect in connection with poorly packed apparatus from the customer's point of view.

The Scotch manager of a mining property in South America, who had several times ordered apparatus from an American firm, said to me one day: "I like their apparatus and their price is all right, but they will never get another order from me, for I cannot get them to follow shipping instructions and it causes me too much expense and delay." Nor did they. The next order went to England.

The American consuls in foreign ports have this same story, and a year or two ago the writer met Mr. Charles M. Pepper, of the United States Department of Commerce and Labor, in Asia. He had found the same complaint everywhere—failure of American firms to follow shipping instructions and to pack properly—and he urged writing an article on the subject.

Packages are handled from fifteen to twenty times on for-

eign shipments—carted, freighted, lightered, stowed on steamers, transshipped to other steamers, lightered and carried on railways again, passed through customs and other warehouses and finally carted again. Often they have to be handled without proper appliances and receive very rough usage.

Some of the things that have been wrong will be touched on first, and this will be followed with a few suggestions. For purposes of illustration and contrast we will take two cases that were shipped to the interior of Asia by two different American firms.

The first case (see Fig. 1) contained a vacuum pump. Dimensions of case, 33 in. x 33 in. x 73 in.; gross weight, 1000 lb.; net, 700 lb. Bearing in mind that 2240 lb., or 40 cu. ft., equal a ton, ship's option, this case measured over a ton. Note waste space between pulley and top of case. This pulley could have been easily removed and placed behind the pump where there was ample room, and the case shortened and a saving of 11.3 cu. ft. made—over ¼ ton. With $10 a ton for ocean freight this would amount to $2.50.

The pump might have been secured by lag screws to the bottom of the case, using the lugs on the base supplies for anchoring the pump, but it was not. The blocks of wood used for chocking, and which show in the photo, were inadequate and not properly secured and came loose in the case. The key which secured the pulley projected beyond the end of the shaft and gouged into the side of the case. When the case was inverted the weight of the pump was consequently thrown on the end of the crank shaft, bending it in the center of the bearing. The labor to straighten this cost the customer $3. The case arrived at destination in perfect condition, and with no extra cost to the exporter the customer might very easily have been saved $6.

The writer could cite a hundred similar cases and within the month saw three crated, oval iron tanks being loaded for South Africa. Each crate took up 1¾ tons absolutely unnecessary space weight. On the three crates this would amount to $65 ocean freight that the customer would pay for somebody's stupidity. But this sort of thing, in lesser degree, happens right along. The shipper has certain stock sizes of packing cases on hand and takes the nearest to a fit; it may be 50 per cent too large, but the customer pays for the extra space freight. Very often the shipper saves himself cents at the expense of dollars to the customer.

Fig. 2 shows a thoroughly well-packed case, and the contents—a waterwheel governor—heavier and much more difficult to pack than the pump. Dimensions of case, 52 in. x 46 in. x 64 in.; gross weight, 2509 lb.; net, 1670 lb. Note all four sides of case braced inside, the braces being cut to fit and secured in place. The governor is securely braced from every point and packed to ride any side up. The base is bolted to 2 x 6's, which are again bolted through to the outside skids. The pulley is removed and secured in place by a cleat and by strips of belting nailed thereto. This case and contents arrived at destination in good condition and form an example of good packing.

The writer saw a case being transshipped from one railway to another in South Africa. It was marked "This Side Up—Handle with Care" in English. The humor of this ought to be apparent. Where such directions are necessary they should be stenciled on the case in the several languages of the countries through which it has to pass. Some firms have learned to do this. The contents of the case were damaged to the extent of about $50.

In all cases where possible packages should be packed to ride "any side up," for such directions are apt to receive little or no notice from steamship and railway companies.

More trouble has been experienced with damage to high-tension transformers during shipment than with any other kind of apparatus, and in all cases it might have been avoided by intelligent packing and with very little additional expense. Some types of transformers can be shipped safely only if kept in an upright position, and it is hardly possible to insure their being so kept when shipped to some parts of the world. For this and for the further reason that they are often beyond the limit of weight that can be carted in foreign countries it is necessary to ship them knocked down.

Coils have been received with the insulation chafed till the copper not only showed bare, but with the windings rubbed together till they looked like a sheet of copper, and, again, jagged with nails and with the leads broken short off at the coil; and where the assembled iron cores or legs were shipped separately the iron and insulation would be in such shape that the iron would have to be relaid, pressed and reinsulated. It is an expensive and time-taking operation to rebuild transformers in a foreign country with unskilled labor and no appliances.

As an indication of how expensive poor packing can be, on one foreign installation breakage, damage and consequent extra labor entailed amounted to nearly $7,000. If the shipper paid for all of this the customer would still be subject to the annoyance and delays, which have a money value as well. Five per cent of this amount spent on the packing, together with a little intelligent supervision, would have saved it all.

When this same installation was completed the forwarding agents at the port of entry wrote that they had twenty-one unidentified pieces of all sorts, with no marks on them, but which they believed must belong to the shipment referred to. Most of them did. There was a case or two consisting of pieces of the crane "I" beams, piping, etc., all of which had been reordered and replaced long before.

This leads up to the marking of packages. Packages should never have the marks painted on by hand. Very often the letters and figures are poor, and people unfamiliar with the language cannot decipher the marks. Again, this sort of marking is made illegible or obliterated by a scrape or rubbing much quicker than stenciled lettering. Again, cases are shipped with all sorts of lettering on them, such as shop-order numbers, requisition numbers, catalog numbers, drawing numbers, etc. They will have infinitely more and better marking for convenience of passing them through the factory to the shipping clerk than is put on them to get them half round the world and by several transshipments. Superfluous marking on packages should be avoided as it leads to mistakes and confusion.

Marking Packages.

Cases should be distinctly marked with stencil.

The final destination should be inclosed in a diamond or square, with the port just over or under.

The serial number of the case should be in 3-in. letters and, together with the destination marking, appear on two sides of the case.

Castings, I-beams and the like should be marked with white paint, and the markings should be placed where they cannot be scraped off in transit.

Iron pipes, rods, etc., of too small diameter to put marks on should have metal tags fastened securely to them by wire with marking stamped on the tags. Paper or cloth tags are hopeless, as they are torn off or the marks become obliterated by oil or water during transit.

The serial number and distinctive marking should appear on two sides of each case. If one marking is scraped off, the other remains for identification. Again, if the case lies with one marking on the bottom the other can be seen. This saves a lot of extra handling and knocking about of cases.

Packing.

Good, strong cases or crates should be used, and the cases should be packed to ride "any side up" where possible. It cannot be expected that cases will be kept right side up on foreign shipments. Often cases are quite strong enough, but the contents are not secured or securely packed and

arrive broken or damaged because they have banged together or against the sides of the case. With heavy articles, such as small castings, large porcelain insulators for transformers and the like, simply packing them in excelsior is not good enough. There should be wooden partitions in

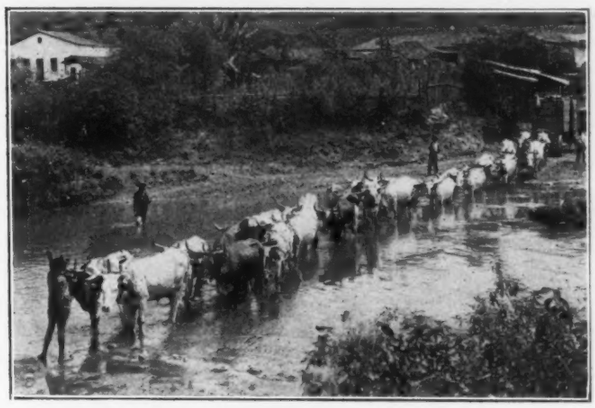


Fig. 3—Hauling 4-Ton Piece of Machinery Through Interior of Brazil.

the case, or, in the case of porcelains or the like, each piece should be bundled in excelsior and tied up in a wrapping of paper or cloth. This will keep it from working through the excelsior.

Cases that contain heavy material should be bound with hoop iron—not wire—and hoop iron is best in any case. Bolts, rivets, insulator pins and such material should not be packed in unreinforced nail kegs or barrels, as, after a few handlings, they go to pieces. Tons of material so packed have arrived at their destination entirely loose, causing any amount of trouble to check and repack. Barrels are not good to use for light material anyway, as the ships allow only four to the ton. Crates for heavy pieces should not be made of ⅞-in. lumber. Good, thick planking from 1¼ in. up should be used, and all heavy pieces, whether in crates or cases, should have skids, and, where possible, castings and machinery should be bolted through to the skids.

As a rule, heavy pieces, say, from 2 tons up, are given more attention by shippers. It is the odds and ends and unclassified articles that need more attention, such as machine parts. These get broken and cause expensive delays and much annoyance. Care should be taken to make cases

Fig. 4—Transport of Electrical Machinery on Jhalum Valley Road, Kashmir, India.

waterproof when contents will be injured by water or damp. Polished and moving parts of machines should be carefully slushed with grease to prevent rust.

No shafting, whether shipped separate or with the wheel, armature or other revolving parts, should ever be supported on chocks where the bearing surface comes, for if the wood is damp or moisture gets in—as it is almost sure to do—the bearing surfaces get rusted and pitted and cause trouble. Bearing surfaces of shafts should be painted with white lead that will dry hard and not rub off, and further protected from mechanical injury by having a canvas covering and wood slats bound with wire around the bearing. The shaft must be cased as well.

Packing should not be made too expensive nor should there be unnecessary tare for the customer to pay freight on. Shipments to some parts of the world have to be taken better care of than others.

Exporters should in all cases make it their business to find out the conditions of transport from the customer and pack accordingly. Often material has to be transported from rail end into the interior by pack animals, mules or camels—sometimes part by pack animals and part by cart. When this is the case anything that can be put in cases of such weight and size that they can be carried on pack animals will reduce the cost of carriage very much. When it is remembered that the cost of transport from rail-end to site of erection is often more than the total cost of ocean and railway transport combined it will be seen that this is something to be taken into consideration. The writer has known of instances where the final haul from rail-end cost from $25 to $90 a ton.

Special shipping instructions should be issued for special

Fig. 5—Transport of Electrical Machinery in Mysore State, India.

cases and the management should see that they are carried out by the shipping department.

Exporters complain that marking and packing that differ from their established routine make them extra trouble and cost more. This seems absurd, especially if shipments are so made that the customer is put to ten times the trouble and expense.

Not all American packing is bad by any means. Some of it is as good as the best, and in most cases there is sufficient material used if it were used to advantage. What is needed is a little more intelligence put into the actual packing, or, maybe, better supervision.

BALL-BEARING MOUNTINGS FOR ELECTRIC MOTORS WITH VERTICAL ARMATURE SHAFTS.

The demand for higher efficiency in electrical machinery has caused ball bearings to be seriously considered of late years for many applications where a few years ago they would have been thought superfluous. Bearings which were first adopted in automobiles simply as a means of increasing the maximum speed of those machines have proved themselves to be not simply reducers of friction, but preventers of wear and tear, and it is for both these qualities that they are now being applied in the electrical field.

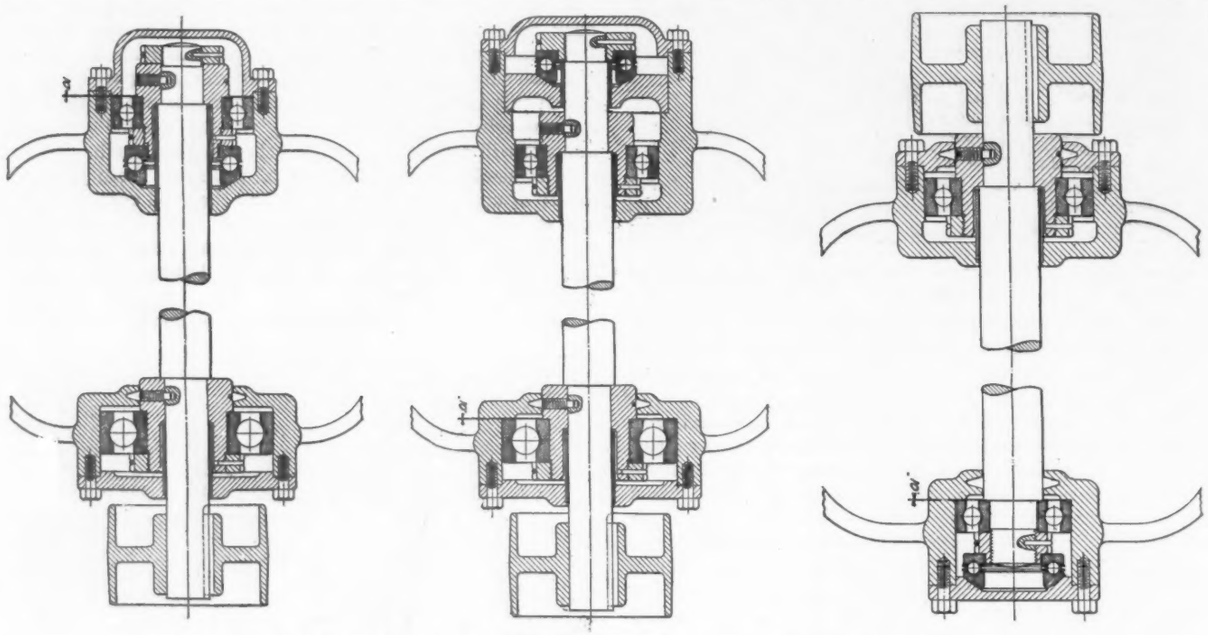
A high-grade annular ball bearing which is properly mounted and not overloaded has an almost negligible coefficient of friction and thus has no sensible wear. Consequently there is a direct saving of friction in the armature bearings and, even more important, a reduction of the air-gap is rendered possible. The accompanying illustrations show mountings recommended by the Hess-Bright Manufacturing Company for use with its type of ball bearings in motors having vertical shafts with the pulley either above or below the motor.

In Fig. 1 the pulley is underneath and the weight of the armature is carried by a thrust bearing under the upper radial bearing. To guard against differences in alignment the thrust bearing has a ball seat, which allows it to select its own position and distribute the load evenly among all the balls. The upper annular bearing is a light press fit on a collar and is clamped solidly by the nut and spring wire shown. This nut is carefully machined and rests on the thrust bearing. The outer race of the annular bearing is a sucking fit in its housing and is unconfined endwise. This permits the outer race to creep slowly around, thereby distributing such minute wear as occurs.

The collar on which the inner race is mounted is itself a press fit on the upper end of the armature shaft, and is secured by the nut and set screw shown. Both nut and set screw are locked by spring wire rings. Oil is retained in this upper ball housing by means of the tube, which is pressed into the base of the housing and extends up around the shaft nearly to the top of the ball bearing. This arrangement is permanently effective, whereas a stuffing box would require occasional attention, besides causing friction. The lower annular bearing is large, to carry the maximum belt pull. It is clamped on a collar, as above described, and its outer race is a sucking fit and unconfined endwise, thereby eliminating the possibility of destructive endwise cramping. The oil-retaining tube is similar to that already mentioned. The oil closure is of the familiar groove and lip type, the lips being at least 3/32 in. wide and bored 1/64 in. larger than the collar which they surround. Capillary action prevents the oil from working out beyond the second lip.

The arrangement of Fig. 2 is similar to that already described, except that the positions of the upper radial and thrust bearings are reversed. The details are identical in principle with those described in connection with Fig. 1. The nut at the top end of the shaft, which rests on the thrust collar, is turned a little smaller in diameter than the hardened ball-bearing ring on which it rests, thereby allowing both ring and nut to assume unconstrained positions in the event of slight errors of machine work existing.

In Fig. 3 the pulley is at the top of the shaft. The armature is supported by a thrust bearing at the bottom of the shaft, and this bearing may be considerably smaller than in the preceding two cases, since the shaft may be safely reduced in diameter at the end. The same clamping nut which holds the lower radial bearing is turned to form a step resting on the thrust bearing. Here again, as in Fig. 2, the nut is turned a little smaller than the inner diameter of the thrust ring to allow slight lateral play. The upper bearing is mounted on a collar with lipped and grooved closure and oil retaining tube of form already described.



Figs. 1, 2 and 3—Ball-Bearing Mountings for Vertical Armature Shafts.

By a slight modification of the above design interchangeable patterns could be made, enabling the same motor to be built with only detailed changes of the housing at the upper and lower ends of the shafts, thus simplifying machine work and rendering it easy to carry a stock on hand or nearly finished.

ELECTRIC SIGN PROJECTOR.

A novel application of electric light for store or other advertising employs the familiar principle of the magic lantern to project the image of the legend in letters of light on the sidewalk or other blank surface. The specially constructed projector comprises a 125-watt high-efficiency glower behind the stencil in which the sign is cut, the light through the openings traversing a set of condensing lenses which bring it to a sharp focus at the plane of the sidewalk. The whole device is contained in a polished-metal tube, 14 in. long and 2⅝ in. in diameter, supported by a tripod base for ceiling, wall or shelf mounting. The glower produces 100 cp and is inclosed in a translucent globe which permits the lateral rays of light to illuminate the show window or doorway in which the projector is mounted. The projector barrel may be adjusted at any angle desired to reach the sidewalk with the image, and the device itself can be mounted in the show-window ceiling or in the doorway vestibule, as is most convenient.

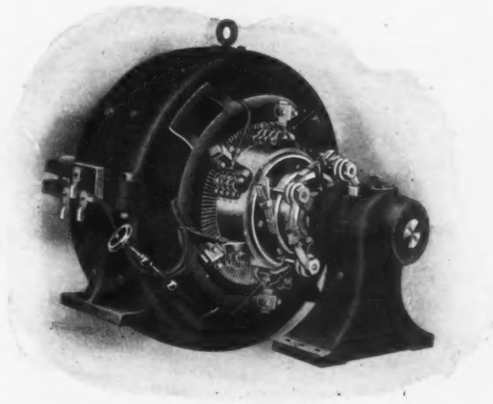
The effect of the illuminated sidewalk sign is a novel one which, in contrast to the blank space of the sidewalk, attracts the attention of pedestrians probably more than an equivalent wall sign or other publicity device consuming the same wattage. The image produced is about 3 ft. in

Electric Sign Projector.

diameter, and while the projector is primarily intended for sidewalk use, it has also been applied to showing signs on walls. Department stores have used the projectors to announce special sales, etc. The projector is made by the Pittsburgh Electric Specialties Company, 927 French Street, Pittsburgh, Pa., a new company organized to market this and other electrical specialties.

THREE-WIRE GENERATOR.

For the operation of direct-current arc and incandescent lamps the use of 110 volts is practically universal, while for the operation of motors above 1 hp or 2 hp the use of 220 volts is almost as thoroughly standardized. The lower voltage is employed for lighting, due to the fact that lamps for this voltage have higher efficiency and longer life, while the higher voltage is employed for motors, mainly on account of the smaller size of the copper wire needed to transmit the current, although there is also some considerable saving in the cost of the motors for this voltage. The ideal system is, therefore, one in which the current is transmitted at the higher voltage and delivered to the lamps at the lower voltage. Such a condition is secured by the use of the three-wire system, which employs two outside mains, carrying the higher voltage current, and a neutral lead between which and either of the mains apparatus requiring one-half the main line voltage may be installed. By the use of this system the output of a given generator may be distributed with three-eighths of the amount of copper that would be required to make the same installation on a two-wire system of the lower voltage. If the load on one side of the neutral lead should always equal that on the other side, the system would be self-balancing and a standard 250-volt generator could be used for the operation of a 125/250-volt three-wire system. Such an ideal condition, however, is not obtainable in ordinary practice, as the load on one side of the system will invariably differ from that on the other side, although in a well-planned installation, with all of the motors on the 250-volt mains, this difference will seldom, if ever, equal 25 per cent of the capacity of the generator. To take care of this unbalanced load numerous methods have been employed. The earliest was the use of two 125-volt generators in series, with the neutral connection between the two machines. This system involved the constant operation of two machines and it was difficult to obtain the desired voltage regulation of the two sides. A later development of the three-wire system came with the introduction of a rotary balancer connected across the mains of a single 250-volt generator. This balancer consists of two 125-volt units so connected that either will automatically act as a generator and supply energy to the unbalanced side of the system, the other unit acting as a motor to operate the generator end. The size of the units of this balancer is usually only that required to maintain an unbalanced current in the neutral of 20 per cent to 25 per cent of the ampere capacity of the generator. This system operates very satisfactorily as regards voltage regulation, but requires an auxiliary rotating machine and if this auxiliary machine meets with disaster the entire system is rendered inoperative. Another means is found in the use of the three-wire generator. The type of three-wire generator described herein is simply a two-wire dynamo equipped with collector rings and an auto-transformer, or compensator, which is essentially a single coil of wire wound on an iron core. This compensator is supplied by means of the collector rings with alternating current from the generator armature. The middle point of the compensator winding has a potential midway between that of the two main wires, and is, therefore, the neutral point of the system. From this point the neutral lead is brought out and the lamps are connected between this neutral and either of the two mains. The standard three-wire generators will carry continuously an unbalanced load, demanding in the neutral wire 25 per cent of the full-load current of the generator, with the voltage on either side of the neutral not varying over 2 per cent from one-half of the line voltage. This regulation of voltage renders three-wire generators satisfactory for meeting the most exacting demands. While any two-wire generator may be equipped in this manner and thus adapted to the three-wire system, it is essential that a thoroughly reliable two-wire machine be employed to start with. Granted that the generator itself is inherently good, its adoption as a three-wire machine cannot but prove satisfactory, as the



Three-Wire Generator.

compensator is in itself one of the simplest pieces of electrical machinery manufactured and, once installed, requires no attention whatever. The machine illustrated herewith is built by the Sprague Electric Works of the General Electric Company, New York City.

Industrial and Commercial News

The Week in Wall Street.

PROGRESS in enlarging the scale of operations was not especially marked during the week, and the usual summer dullness prevailed. Sentiment, however, was vastly improved, based upon the many favorable indications for good business in the second half of the year. More advancement has been made recently in the iron and steel trades, perhaps, than in other industries. The volume of orders received in the past few months has been on an increasing scale, and the prospects for curtailing the usual mid-summer slackness at the mills are considered especially bright. In fact, it is stated that the business carried by the steel trade into the second half of the year is better than in 1910. Demand for wire for export has increased as a result of price reductions, and the sheet mills are reported to be turning out their product in the greatest amounts since March. The outlook in the trade is brightened by the heavier inquiries for steel cars, rails and various railroad equipment, necessitated by supposedly low stocks and by the imminence of crop transportation. A favorable incident of recent date was the disposal by the Erie Railroad Company of $6,000,000 equipment trust certificates, the proceeds of which are to be used in payment for some 300 freight cars and other rolling stock. In view of the fact that the report of low stocks is not confined solely to the railroads, but is believed to be the condition in many branches of trade, it is hoped that the improvements of the past month will culminate in July in a general buying movement, increasing with the successful outcome of this year's crops. So widespread is the influence of the crop situation that, in spite of removal of many of the obstacles that stood in the way of trade revival in the first part of the year, the waiting attitude is still apparent. Necessary moisture was received in the agricultural sections last week, and the outlook for excellent harvests is little changed. Business failures for the week ended June 29, as reported by *Bradstreet's*, were 227, as compared with 222 for the last week, 197 for the same week in 1910, 213 in 1909, 236 in 1908 and 135 in 1907.

The Copper Market.

LIGHTER demand for domestic copper was noticed in the past week, accompanied by a weaker tone both here and abroad. Prices were not greatly affected, and quotations of 12⅝ cents and 12¾ cents are general throughout the trade, with good prospects for 13-cent copper before long. Most of the efforts to sell were made by the smaller interests, who were said to be willing to shade slightly to dispose of material. Prices abroad advanced early in the week, but reacted later, with very little business reaching this country from the other side. Liquidation of standard contracts by speculators abroad was probably the chief feature of interest in the copper trade during the week. Consumers are believed to be supplied for immediate needs, but not for any length of time, and increase in the buying movement is expected to follow the June report of the Copper Producers' Association. In any event, it is hoped that the report will show a better relation between consumption and production than has been in evidence during the year, for the reports of necessity for further enlargement of capacity at the mines do not seem consistent with the meager statistics showing the great excess of production over consumption at this time. Exports for the month of June were about 27,498 tons. The daily call on the Metal Exchange, June 30, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.25	12.35	.....
July	12.25	12.35	12.30
August	12.25	12.35	12.30
September	12.25	12.35	12.30
October	12.25	12.35	12.30

The London market, June 30, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	57 2 6	57 0 0
Standard copper, futures	57 13 9	57 11 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.35c	11.57½c
London, spot	£57 10 0	£53 7 6
London, futures	52 2 6	54 0 0
Best selected	61 10 0	57 5 0

Industrial and Commercial Notes.

Diesel Oil Engines.—Small central stations, refrigerating plants, and many industrial lines are finding oil-engine units useful for meeting their power requirements, as shown by the following sales of Diesel oil-engines: Two 225-hp engines have been purchased by the Hershey Chocolate Company, Hershey, Pa., and are now being installed; the Municipal Lighting Plant, of Thibodaux, La., which was recently equipped with two 120-hp engines, was placed in operation a few weeks ago; the Ennis Ice, Light & Power Company, of Ennis, Tex., which had one 225-hp oil engine in operation, has added another rated at 170 hp; the Anheuser-Busch Brewing Association, of St. Louis, has just completed the installation of two 225-hp Diesel oil engines; the Arkansas Cold Storage Company, of Little Rock, Ark., has placed an order for two 120-hp oil engines; the new power station of the General Phosphate Company of Florida, equipped with oil engines, is nearing completion; the Cleburne Gas & Electric Company, of Cleburne, Tex., has placed an order for a third 225-hp oil-engine; a 225-hp oil-engine has been installed in the shops at the United States Naval Torpedo Station, at Newport, R. I.; the Municipal Lighting Plant of Mansfield, Mass., has ordered a 225-hp engine, making the fourth oil-engine unit in this station; the Plant Ice & Power Company of Plant City, Florida, has placed an order for a 120-hp engine; the Granite Falls Electric Works of Granite Falls, Minn., has ordered a 170-hp oil engine to be used as an auxiliary in the hydroelectric plant; the Corpus Christi Ice & Electric Company of Corpus Christi, Tex., has ordered a 225-hp oil engine.

Crocker-Wheeler Equipment.—Among sales recently booked by the Crocker-Wheeler Company are the following: Generating equipment and motors for the Angel Guardian German Catholic Orphan Society of Chicago, including generator, balancer and eight motors of various sizes; Cuban Trading Company, of Havana, Cuba, generating equipment, twenty motors of various sizes, switchboard equipment and installation of Remek transformers; Maris Brothers, Philadelphia, consignment of motors, including twenty-four crane motors; additional equipment for the Postal Telegraph Cable Company of Texas, including sixteen small motor-generator sets; Hashaw, Fuller & Goodwin Company, Elyria, Ohio, generating equipment, including three generators and ten motors of various sizes; Huerfano Coal Company, Denver, Colo., equipment including one 250-kva alternator, motors and Remek transformers; additional equipment for the Capac Paper Company, Capac, Mich., including one 200-kw generator; additional equipment for the Illinois Steel Company, Gary, Ind., including six steel mill motors; three motor-generator sets for wireless telegraph service for the Telefunken Wireless Telegraph Company of New York City; motor-generator equipment for the Savannah Electric Company, Savannah, Ga.; several annual contracts for Remek transformers, and orders for fifty-five induction motors for mill service.

General Electric Orders.—The General Electric Company has recently received an order from the Clinchfield Coal Corporation, Dante, Va., for six 6-ton gathering locomotives and four 10-ton mine haulage locomotives. One of the 10-ton locomotives and five of the 6-ton locomotives will be installed at the mines at Dante, Va., while the remaining one 6-ton and the three 10-ton locomotives will be installed at Hurricane, W. Va. The French River Textile Company of Mechanicville, Conn., has placed an order for one 500-kw turbine, one 200-kw generator and one 20-hp induction motor. This apparatus is for the joint use of the French River Textile Company and the Putnam Light & Power Company.

Canadian Pacific's Telephone Dispatching.—The telegraph department of the Canadian Pacific Railroad has completed statistics which show that the number of miles on this system equipped with telephone train dispatching circuits is 3955, which represents 71 miles more than upon the Santa Fé, its nearest competitor.

Keokuk Electrical Properties.—The Stone & Webster Engineering Corporation, of Boston, which is largely interested in the development of the water-power proposition across the Mississippi River between Keokuk, Ia., and Hamilton, Ill., some time ago entered into a tentative agreement to purchase the electric and gas plants upon condition that a certain franchise be granted. This franchise was voted upon by the citizens of Keokuk June 12, 1911, and carried almost unanimously. The present condition of the utilities named is very poor, and Stone & Webster proposed to set about bringing the properties up to date immediately upon the grant of the franchise. The proposed improvements will cover the street railways, including a short interurban branch, the street lighting, general residence lighting, power, gas. The present electric plant is equipped with direct-current apparatus for railway service at 550 volts, and also supplies power in rather small quantities. The alternating current, used almost entirely for lighting, is single-phase, 133 cycles, and is generated at 1100 volts. Energy is furnished to Hamilton, Ill., and Warsaw, Ill. The street-lighting system for both Keokuk and Hamilton is by the old-fashioned open series arc, consuming 9.6 amp. The energy is furnished by two Brush arc machines, driven by a single direct-current 550-volt motor. The provisions of the franchise are that the street railway franchise, which had fifteen years yet to run, be extended to twenty-five years, which means a ten-year extension of the time of the present franchise, and that the central-station franchise, which gives the right to erect, operate and maintain a plant on the streets and in the alleys of the city and had fourteen years to run, be extended to twenty-five years. The city commissioners have entered into a tentative contract with the Stone & Webster interests for street arc lights for a period of seven years, which contract is now binding, the price to be $60 per year per lamp of the most approved type, to burn all night and every night. It is also understood that Stone & Webster have asked for a similar franchise from the city of Hamilton, Ill., mentioned above. At the above-mentioned election the city of Keokuk also established a Department of Publicity Development and General Welfare.

Rubber Market Conditions.—Samuel P. Colt, president of the United States Rubber Company, in speaking of conditions in the rubber trade, said in part: "The immediate outlook for the general line of mechanical goods is not encouraging. The company's output of mechanical goods for the last two months has been about 25 per cent below the corresponding months last year. Boot and shoe sales are also much below 1910, and we find very little desire to purchase by the jobbers. Our plants at present are working only about 60 per cent of capacity. There seems to be a waiting disposition in various quarters growing out of the uncertainty as to tariff revision and the interpretation of the Oil and Tobacco decisions, and as to the manner in which these two companies will reorganize in compliance with the Supreme Court ruling. Incidentally there is too much legislation. If business conditions in the fall show improvement I expect to see a betterment in the demand for rubber goods. Retailers, I find, are not anxious to purchase, although I do not believe that they had any great quantity of goods left over from last year. A year ago they showed the same feeling as now in regard to buying and for that reason no large stocks were held over. If better weather conditions prevail in the fall I expect to see business improve."

Capital in June Incorporations.—A record of papers filed in the Eastern States in June, with an authorized capital of $1,000,000 and over, and including increases in capital, shows a total of $159,550,000, which is a decrease of $4,045,000 as compared with May 1, and a decrease of $71,769,400 as compared with June, 1910. The record of charters taken out by other companies, with an individual capital of $100,000 and over, the figures including States other than those in the East, brings the total for the month up to $232,900,000, which compares with $326,144,000 for May of this year, and with $311,674,400 for June, 1910.

Recent Westinghouse Orders.—Among recent orders received by the Westinghouse Electric & Manufacturing Company are: Equipments for three substations, consisting of nine 110-kw, 33,000-volt, oil-insulated, self-cooling transformers, three five-panel switchboards and the necessary lightning protective apparatus, for the Chicago, Ottawa & Peoria Railway Company, Ottawa, Ill.; from the Merchants' Light & Power Company, Ogden, Utah, an order for four 500-kw, oil-insulated, water-cooled transformers and five 75-light metallic flame arc lamp outfits; for one 1500-kw air-blast transformer with blower outfit, from the Kentucky Electric Company of Louisville, Ky.; from the Morris County Traction Company, Morristown, N. J., ten quadruple equipments of No. 101-B-8 railway motors for type K-28-B control; from the Marshall Traction Company, of Marshall, Texas, for two double equipments of No. 307 interpole railway motors with Type K-10 control. Foreign railway motor business recently secured includes an order from Walter Brothers & Company, of Rio de Janeiro, Brazil, for fifteen double equipments of No. 101-G motors with type K-10-A control.

United Wireless to Complete Contracts.—The application of the New York receivers for the United Wireless Company for permission to raise funds for the receivers of the company in New Jersey and in Ohio, in order to carry on business, has been granted. Owing to the recent law requiring that all vessels traveling in excess of two hundred miles from the port of call, carrying fifty passengers and crew, be equipped with wireless telegraph systems by July 1, the United Wireless Telegraph Company had contracts for supplying thirty ships by that time.

Chicago Pneumatic Tool Company.—W. O. Duntley, president of the Chicago Pneumatic Tool Company, who recently sailed for Europe, is quoted as saying that the business of the company continues satisfactory, considering the present condition of trade, and that the plants of the company are kept running at full time by the volume of orders received. Present earnings of the company are close to 10 per cent per annum, and the officials of the company are gratified by the results of the first half of the current year.

Central-Station Franchise Compensation in Chicago.—A check for $385,192.97 has been sent to the city comptroller of Chicago by the Commonwealth Edison Company, as 3 per cent of the company's gross receipts for the year ended May 31, 1911, in compliance with the compensation clause of the franchise under which the company operates. The amount of compensation paid the city by the Commonwealth Company is $62,000 more for the year mentioned than the sum paid for the preceding year.

Burlington Light & Power Company.—At the annual meeting of the stockholders of the Burlington (Vt.) Light & Power Company the following directors were elected: Messrs. M. W. Stroud, S. P. Curtis, F. E. Burgess, F. H. Parker and Leslie B. Miller. At the directors' meeting which followed these officers were elected: M. W. Stroud, president; W. T. Robinson, treasurer; Leslie B. Miller, secretary, and W. L. Fox, assistant secretary and treasurer.

Edison Factories for Newark.—A site in the Silver Lake section of Newark, N. J., has been selected by Thomas A. Edison for the erection of two factories, One of these will be used for the building of storage battery automobiles and the other will be used for the manufacture of the new storage battery cars which were recently tested by Mr. Edison on the lines of the Erie Railroad.

Republic Railway & Light Company Incorporated.—The Republic Railway & Light Company, plans for the formation of which were described in the issue of July 1, has been incorporated at Trenton, N. J., with a capital of $17,500,000. Stock of the company is divided into $10,000,000 preferred, which is to bear 6 per cent cumulative dividends, and $7,500,000 common.

Equipment for Southern Traction Line.—The Ohio Brass Company will furnish all overhead materials for the 150-mile, 44,000-volt transmission line of the Greenville, Spartanburg & Anderson Railway and Piedmont Traction Company. The orders include all porcelain insulators for the line, together with those for the telephone, signal and feeder lines.

Electric Locomotives for South.—The Tennessee Coal, Iron & Railroad Company has placed an order with the General Electric Company for four 18-ton locomotives. These will be 220-volt, three-phase, 25-cycle locomotives and their service will consist chiefly of switching and placing cars in and about the company's plant at Corey, Ala.

Aluminum Notes and Prices.—The aluminum market has been quiet during the week, with ingots for smelting held at 21@21½ cents spot No. 1, the base for large ingots, while rods and wire are held at 31 cents, with sheets at 33 cents.

Sedalia Light & Traction Company.—A decree has been rendered to foreclose the $807,000 mortgage on the property of the Sedalia (Mo.) Light & Traction Company, provided the indebtedness is not satisfied in forty days.

Financial.

The Week in Wall Street.

IRREGULARITY and weakness were the features of the New York market during the week, with interest and sales decreasing to a minimum on Saturday last on account of the holidays. Price changes throughout the list were of no particular moment, and no adverse effect resulted in the Steel shares upon news of indictment of several subsidiary company officials in the wire cases cited elsewhere in this issue. Returning interest in long-term issues was noted in the bond market of the week, while no decrease has occurred in the activity which has characterized this market for the past few months. Good business in Wall Street in the immediate future is considered likely, not only from the re-investment demands but from the better prospects for public buying. Improvement in the latter half of the year is expected by many in financial quarters, not so much in the way of large undertakings or large gain in prices as in conservative advancement, with establishment of confidence and stability. Much of this optimism is caused by the fact that activity in other years has started about this time, and some of it no doubt is due to the brighter outlook in political and crop conditions. These factors, including possible tariff changes, the size of the harvests and the scope of the government investigations, are the paramount questions to be settled before conditions will approach the normal either in Wall Street or the country as a whole. That ultimate good will result from the government examinations is a matter of general belief, but the attention of many who might be attracted to Wall Street is seemingly more concerned at this time with finding out the full requirements of the Sherman law and means to establish their affairs on a basis in keeping with these than with the possibilities of the stock market. Provision for July disbursements resulted in heavy demand for call money during this week, but there was no noteworthy change in prices. Rates July 1 were: Call, 2@2¼ per cent; ninety days, 2¾@3 per cent. The quotations in the tables are those of the close, July 1.

NEW YORK.

	June 26.	July 1.	Shares Sold.		June 26.	July 1.	Shares Sold.
All. Ch.....	9*	9*	———	Int. Met., pf.	49¾	50¼	16,900
All. Ch., pf..	29½*	30	50	Mackay Cos..	89½*	89½*	100
Amal. Cop..	70⅛	69⅝	33,200	Mackay C.,pf.	74⅞*	74⅞*	100
Am. D. T...	20½*	20½*	———	Man. Elev...135		135*	100
Am. Loco...	40	40¾	800	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	109*	109*	———	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	80*	80*	———	Steel, com...	78⅞	78⅝	405,650
Am. T. & T.	148¾	139⅛	20,000	Steel, pfd...	118¾	118¼	5,338
B. R. T...	80½	81½	27,900	W. U. T....	79½	78⅞	2,400
Gen. Elec...	162	161¼	2,500	West'h, com.	76	76*	2,250
Int. Met....	17⅝	17⅞	5,600	West'h, pfd..	119	119*	267

PHILADELPHIA.

	June 26.	July 1.		June 26.	July 1.
Am. Rys.....	44	43¾*	Phila. R. T.....	19⅝	19¼
El. Co. of A.....	12½	12⅛*	Phila. Elec.....	17⅜	17¼
Elec. St. Bt'y.....	54½	53¾	Phila. Trac.....	86½	86½*
Elec. St. Bt'y., pfd..	30*	30*	Union Trac.....	49	49¼

CHICAGO.

	June 26.	July 1.		June 26.	July 1.
Chi. City Ry.....	186*	186*	Chi. Tel. Co.....	124½	124¼*
Chi. Rs., Ser. 1....	80*	87½*	Met. El. Co.....	26⅝*	27*
Chi. Rs., Ser. 2....	22	26½	Met. El., pfd.....	73½	..*
Com. Edison.....	129½*	130	Nat'l Car.....	120*	120*
Chi. Subways.....	3⅞*	4	Nat'l Car, pfd.....	118½*	118½*

BOSTON.

	June 26.	July 1.		June 26.	July 1.
Am. T. & T.....	149	139⅛	Mex. Tel.....	4½	4½*
Cum. Tel.....	156¾*	156½*	Mex. Tel., pfd.....	6¼*	6¼*
Edison E. Ill.....	285*	283	N. E. Tel.....	147	146¼
Gen. Elec.....	163	161½*	W. T. & T.....	20*	18½*
Mass. E. Ry.....	22½	22¾	W. T. & T., pfd....	96½	96*
Mass. E. Ry., pf....	91½	93½			

*Last price quoted.
Shares sold for the week, June 26 to July 1.

Financial Notes.

Ohio Public Utilities Consolidated.—The holdings of the Warren Water & Light Company and those of the Hydro Electric & Gas Company, both of Warren, Ohio, have been sold to the Trumbull Public Service Company, of the same city. The Trumbull Public Service Company is composed of all the directors of the Hydro Electric Company, George W. York, of Otis & Hough, of Cleveland, and Henry L. Doherty, of New York City. The deal was the result of plans formulated by the late Elmer W. Gillmer, of Warren, and was consummated by his former associates. The Warren Water & Light Company was a consolidation of the Warren Water Company and the Warren Electric Light & Power Company, and had held franchises secured by itself or its predecessors, for nearly twenty-five years in the territory. It was incorporated under its present name some eight years ago, and E. L. B. Gardiner was president, with offices in Paterson, N. J. The Hydro Electric & Gas Company was organized some five years ago, and supplied energy to Newton Falls, Warren, Niles and Leavittburg, from its stations in these townships. The company owned franchises and rights in Trumbull and Geauga counties, consisting of sixteen parcels of land in Warren city and Warren and Newton townships, and nineteen parcels of land in Parkman township, containing valuable power sites not yet developed. The Trumbull Public Service Company has filed for record a mortgage deed for $1,500,000 to provide for payment of 6 per cent gold mortgage bonds, and the capital stock of the company, with a present issue of $700,000, is $1,700,000, against which is the mortgage mentioned above.

Postal Telegraph Matters.—The July issue of *The Postal Telegraph,* the monthly bulletin of the Postal Telegraph-Cable Company, contains a number of clippings from public prints relating to competition with other telegraph and cable companies in Texas, and also an article headed "Monopoly in Texas," of which the following is a part: "Does Texas want a monopoly in telegraph facilities or does Texas wish competition? That is one question. Can the Postal Telegraph-Cable Company of Texas (controlled by Bell interests) give real competition with the Western Union (controlled by Bell interests)? That is the second question. Is the Texas Postal correct in its claim that for thirty-six years the Mackay interests must turn over to the Texas Postal (controlled by Bell interests) all their telegraph business to Texas? Or, on the contrary, are the Mackay interests correct in their contentions; first, that they go free from the old contract because one of its terms allows them to withdraw if the Texas Postal and Western Union should fall under the control of the same interests; second, that if the Mackay interests continued to act under that contract, they would be *particeps criminis* to the illegal combine of the Texas Postal with the Western Union and Bell Telephone; third, that the Texas public has something to say about all this? It is for the State of Texas to decide whether it will tolerate a monopoly or whether it shall have competition in telegraphy."

Jenney Electric Manufacturing Company Sold.—The superior court has approved the sale of the Jenney Electric Manufacturing Company plant, mentioned in the issue of July 1, to the American Rotary Valve Company, of Chicago. The bid of the Chicago firm was $135,000. The plant will be reopened in July under the direction of the purchasers, Austin H. Hart, secretary, being in charge. The American Rotary Valve Company contemplates closing its plant at Niles, Cal., and also its plant in southern Illinois. The work done by these factories will in the future be turned out by the Jenney plants near Anderson. More than $100,000 will be expended on improvements at the plant, and according to Mr. Hart 500 mechanics will be employed by the end of the year. For the present the purchaser expects to continue the manufacture of Jenney electric motors and printing-press equipment, but will later manufacture street-car air compressors, vacuum cleaners and other products in which rotary valves are used. Extensive experimenting will be done to perfect a rotary valve for use in gas engines. The American Rotary Valve Company is a new corporation incorporated last February and its directors are: William Waller, V. T. Lawson, Warren C. Fairbanks, Austin H. Hart, Delevan H. Smith and William Waller, Jr.

Cincinnati, Newport & Covington Light & Traction Dividend.—Directors of the Cincinnati, Newport & Covington Light & Traction Company have declared a quarterly dividend of 1¼ per cent on the common stock and 1⅛ per cent on the preferred stock, both payable July 15, placing the common stock on a 5 per cent basis. This is obligatory under the lease which the Columbia Gas & Electric Company holds on the property. It is reported that the common stock will be placed on a 5½ per cent basis in April next, and that this will be increased to 6 per cent in April next, which will be the permanent income basis after that time.

United States Light & Heating Company.—Discussion of the advisability of increasing the par value of the common and preferred stocks of the United States Light & Heating Company was made at the recent directors' meeting. Application to list the stocks on the New York Stock Exchange will be made in case the change is made. A committee was appointed to consider the change, and its report will be taken up by the board at a future meeting.

United Railways & Electric Company of Baltimore.—Commenting upon the proposed issue of $3,125,000 three-year collateral trust 5 per cent convertible notes of the United Railways & Electric Company of Baltimore, which will be used to provide funds for retiring maturing underlying bonds of the company, as mentioned in the *Electrical World* July 1, Alex. Brown & Sons, of Baltimore, state in part: "We sum up from the company's annual report for 1910 as follows: The report states that the physical condition of the property is 'on the whole better than that of any street railway in the country.' For the year 1910 net earnings over and above operating expenses, taxes, fixed charges, rentals, etc., were $1,226,853, of which amount $864,048 in pursuance of a program for the rehabilitation of the property was expended upon improvements, etc. The company on June 1, 1911, resumed payment of interest on its income bonds. On the basis of the above given earnings for 1910, after deducting operating expenses, fixed charges, taxes, rentals and interest on income bonds (less annual payments on securities retired with the proceeds of these notes), the surplus applicable to interest on these notes is over five times the interest charges. This is without allowing for any increase of net earnings during 1911. We will receive subscriptions for the above notes at 98½ per cent, at which price they pay slightly over 5½ per cent if allowed to run to maturity and proportionately higher if redeemed prior thereto; payment to be made in full in Baltimore or New York funds at our office on July 15, 1911, at which time either the notes or temporary certificates will be delivered, exchangeable for notes when prepared. The entire issue of notes has been underwritten by a syndicate. Subscriptions will be closed at 12 o'clock noon on July 8, 1911, or earlier, we reserving the right to close the subscription at any time without notice (except as to stockholders as hereinafter mentioned), to reject any application and to allot smaller amounts than those applied for. The stockholders of the company of record at noon on July 8, 1911, will be given precedence in the allotments; that is to say, every subscribing stockholder will receive an allotment of $100 of notes or multiples thereof for every ten full shares of stock or multiples thereof notwithstanding any over-subscription for the notes. The above issue is dependent upon the approval of the stockholders of the company and the Public Service Commission of Maryland."

Consolidated Gas & Electric Bonds.—The $1,000,000 4½ per cent bonds of the Consolidated Gas, Electric Light & Power Company of Baltimore, which were listed on the London Stock Exchange, as mentioned in the issue of June 22, have been offered to securities at 89. The securities are due February 14, 1935, and are a part of a total authorized issue of $15,000,000, there being $11,788,000 outstanding, $2,877,000 of which have been deposited as collateral security for notes of the company and bonds of the Baltimore Electric Company. The securities are a first mortgage on the Westport power station and on other parts of the gas and electric properties. They are also a general mortgage on the entire business subject to the outstanding issues of constituent companies aggregating $13,928,000, which amount cannot be increased.

Monterey Railway, Light & Power Earnings.—Gross earnings of the Monterey Railway Light & Power Company for the year ended December 31 were $144,182, which represented an increase of $22,095 over the gross returns of the previous year. While operating expenses also increased $14,483, amounting to $93,297, net earnings were $50,885, showing a gain of $7,612 in this term for the year. Other income added made a total income of $452,759, which was $132,652 larger than in the year preceding. Deducting interest charges of $253,472, there was left a balance of $199,287 available for dividends, $40,974 larger than the previous balance. Preferred dividends amounting to $25,000 were paid, leaving a surplus for the year of $174,287, which, added to the previous surplus, made a total of $381,175.

New England Traction Companies Merged.—Announcement is made of the absorption of the Old Colony Street Railway Company by the Boston & Northern Street Railway Company. Mention of meetings of each of these companies, June 2, at which it was voted to merge the two, was given in the issue of June 8. While the companies operate in a large number of towns and cities in Massachusetts, New Hampshire and Rhode Island, their lines do not connect, and as the Railroad Commission, under the general street railway law, cannot approve a consolidation of companies which have no physical connection with each other, special legislation was necessary to effect the merger. The companies have been under the same management for a number of years, but have been operated as separate companies. Both are owned by the Massachusetts Electric Companies, which control several electric railway companies through leases. The present offices of the merged companies will continue at 84 State Street, Boston, and Patrick F. Sullivan, Robert S. Goff and Charles R. Rockwell, who at present are respectively president, vice-president and treasurer of the merging companies, will continue in these capacities with the consolidated systems. The board of directors of the Boston & Northern Street Railway Company will be increased by the number of directors on the board of the Old Colony Street Railway Company.

Bronx Gas & Electric Company.—A report issued by the Public Service Commission for the First District of New York shows that operating revenue of the Bronx Gas & Electric Company for the year ended December 31, 1910, for electricity sold, was $130,380, a gain of $14,231 over this item in the previous year. The operating income, after deduction of expenses and taxes, was $37,233, which was $9,405 in excess of the result in 1909. The combined income from the sale of electricity and gas, after deducting of expenses and taxes, was $72,147, which is an increase of $4,107 over the figures for 1909. The profit and loss surplus, as of December 31, 1910, is given as $77,360.

Havana Electric's Year.—The most satisfactory year in the history of the Havana Electric Railway Company ended Dec. 31, 1910. Gross and net earnings were the largest on record, the former amounting to $2,656,980, comparing with $2,488,647 for the previous year, and the latter earnings being $1,291,339, as compared with $1,237,548 in 1909. In view of the large returns the dividend on the common stock was increased to 6 per cent, double the previous rate. General improvement is recorded in the various departments of the company, the gross earnings per mile being $44,000.

Narragansett Electric Lighting Company Stock.—Following a recent meeting of the board of directors of the Narragansett Electric Lighting Company, the treasurer was instructed to call in the $500,000 debenture certificates of the series of 1913, which were issued January 1, 1909, and to issue capital stock of an equal amount at par to the certificate holders of record July 1. This action increases the capital stock of the company to $4,500,000. It had been intended to redeem the debentures in 1913, but the affairs of the company have permitted earlier action.

Aberdeen Light & Power Company.—First-mortgage, 6 per cent twenty-year gold bonds of the Aberdeen Light & Power Company, of Aberdeen, S. D., are offered for sale by the Chicago Savings Bank & Trust Company. It is said that at the present time the net earnings are practically three times the interest charge and that the company has liberal franchises extending well beyond the maturity of the bonds, with favorable city contracts. The price is 101½ and interest, netting about 5.90 per cent.

DIVIDENDS.

Chicago Pneumatic Tool Company, quarterly, 1 per cent, payable July 25.

Edison Electric Illuminating Company of Boston, quarterly, 3 per cent, payable August 1.

Norfolk & Portsmouth Traction Company, quarterly, preferred, 1¼ per cent; payable July 10.

Pacific Coast Power Company, semi-annual, $2.50 per share, and extra dividend, 50 cents per share on common; payable July 17.

Railway & Light Securities Company, semi-annual, preferred, 3 per cent; common, 2 per cent, both payable August 1.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.					
May, 1911	$606,018	$367,170	$238,848	$50,310	$188,538
" 1910	570,195	322,540	247,655	47,717	199,938
NASHVILLE RAILWAY & LIGHT COMPANY.					
May, 1911	$163,174	$97,539	$65,635	$49,013	$16,622
" 1910	148,694	88,722	59,972	48,567	11,405
NORTHERN OHIO TRACTION & LIGHT COMPANY.					
May, 1911	$228,693	$124,656	$104,037	$44,329	$59,708
" 1910	207,323	111,250	96,073	43,375	52,698
TWIN CITY RAPID TRANSIT COMPANY.					
May, 1911	$658,739	$311,974	$346,764	$140,079	$206,685
" 1910	627,946	289,382	338,564	140,112	198,451

General News

Construction News.

ALEXANDER CITY, ALA.—The Industries Light & Power Company, recently formed, is reported to be contemplating the construction of a dam and power plant to supply electricity to light the town.

BIRMINGHAM, ALA.—Morris Knowles, consulting engineer, of Pittsburgh, Pa., engaged by the City Commission to investigate the municipal electric-light plant at North Birmingham with a view of enlarging the plant to supply electricity for lighting the streets of Greater Birmingham, has advised the commission that the plant can furnish the service with some improvements and extensions, which can be made at a comparatively small expense.

DOTHAN, ALA.—It is reported that plans and specifications have been prepared for extensions and improvements to the municipal electric-light plant and water-works system, to cost about $75,000. The proposition to issue bonds for the proposed work will be submitted to a vote.

GADSDEN, ALA.—It is reported that it is proposed to develop the water power of the Little River, on Lookout Mountain, to generate electricity, which will be transmitted to Gadsden and other small cities in this section. It is said that $60,000 has already been spent in purchasing land and making surveys in connection with the project. It is expected that 20,000 hp will be available.

HARTSELL, ALA.—Bonds to the amount of $28,000, it is reported, will be sold by the city, the proceeds to be used for the installation of an electric-light plant, water works and sewer system. Bids will be asked for the work when the bonds are sold. Xavier A. Kramer, of Magnolia, Miss., is engineer.

RUSSELLVILLE, ALA.—Contracts have been awarded by the Mayor and Board of Aldermen for the construction of an electric-light plant and water-works system in Russellville to W. W. Moore, of Birmingham, Ala., to cost about $24,000. Plans for the plant were prepared by Professor Kay, of the University of Alabama, who will supervise the installation of same. The street-lighting system calls for 107 lamps.

HUNTINGTON PARK, CAL.—The City Council has passed an ordinance fixing the rate to be charged for electricity for the coming year at 8 cents per kw-hour. The present rate is 12 cents per kw-hour, with a minimum rate of $1 per month. The Pacific Light & Power Company supplies electrical service in Huntington Park. It is expected that the matter will be carried to the courts.

ONTARIO, CAL.—The City Council has awarded the Ontario Power Company contract to supply electricity to operate the pumps at the new municipal water system at Fourth Street. Under the terms of the contract the city can terminate the same at the end of two years by giving the company ninety days' notice and payment of $250; at the end of three years upon payment of $165, and at the end of four years upon payment of $80. Most of the pumping is to be done between the hours of 10 p. m. and 7 a. m., for which the rate will be 1 cent per hp-hour; for service between the hours of 7 a. m. and 4 p. m. the charge will be 1¼ cents per hp-hour. No pumping is to be done between the hours of 4 p. m. and 10 p. m., except in case of fire, for which 1¾ cents per hp-hour will be charged.

PASADENA, CAL.—The contract for installing a generating unit in the municipal electric-light plant has been awarded to the Westinghouse Company, of Pittsburgh, Pa., for $22,855. C. W. Koiner is general manager of the municipal electric plant.

SAN FRANCISCO, CAL.—The Pacific Wave Power Company has leased certain lands along the shores of Golden Gate at Baker's Beach, opposite Twenty-ninth and Thirtieth Avenues. The company is planning to construct and operate a miniature ocean wave power plant, work on which will begin at once. Omer Denny is consulting engineer, and W. H. Chamberlain is president.

SAN FRANCISCO, CAL.—The control of the City Electric Company was taken over by the Great Western Power Company on July 1, bringing the company into active competition with the Pacific Gas & Electric Company. The City Electric Company has a franchise to extend its service in all parts of San Francisco. The Great Western Power Company has a large hydroelectric plant on the North Fork of the Feather River in Butte County with high-tension transmission extending into Oakland, where the company has a large steam auxiliary plant.

FT. COLLINS, COL.—Steps have been taken by the City Council for the construction of a municipal electric-light and power plant. The City Engineer has been instructed to make surveys and estimates on the cost of installing a plant about 50 miles west of Ft. Collins.

EAST LYME, CONN.—The Lyme Power Company, it is reported, has been granted a franchise to supply electricity in East Lyme.

NEW HAVEN, CONN.—Preparations are being made by the Yale University to build a large heating and lighting plant at the corner of Ashmun Street and Winchester Avenue, to cost about $500,000. The new plant will supply heat and light for the university buildings.

PLAINFIELD, CONN.—Surveys have been made by the People's Light & Power Company, of Danielson, Conn., for the erection of its new transmission line from the Plainfield power house to Central Village. The line will be built over private right of way most of the distance.

WASHINGTON, D. C.—The contract for supplying electric incandescent lamps, under bids opened June 19 by the general supply committee, has been divided between the Columbia Incandescent Company, 2115 Locust Street, St. Louis, Mo., and the General Electric Company, of Schenectady, N. Y.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 11, for furnishing at the various navy yards and naval stations the following supplies: Washington, D. C.—Schedule 3722—Miscellaneous fire-alarm boxes, etc. Brooklyn, N. Y.—Schedule 3728—900 dry cells and miscellaneous electrical fuses. Norfolk, Va.—Schedule 3728—25,000 glass tube fuses. Boston, Mass.—Schedule 3727—5700 lb. naval brass rod; 860 lb. sheet brass; 750 lb. sheet copper, etc. Bids will also be received at the same place until July 18 as follows: Washington, D. C.—Schedule 3738—For six motor-generator sets. Newport, R. I.—Schedule 3733—Copper tubing. Brooklyn, N. Y.—Schedule 3739—Copper tubing. Applications for schedules should give the numbers desired.

ST. PETERSBURG, FLA.—Plans are being considered by the St. Petersburg Investment Company for the construction of power plant, car barns, etc. R. E. Ludwig is consulting engineer, and H. Walter Fuller manager of the company.

ATHENS, GA.—The Athens Electric Railway Company is enlarging its Mitchell's Bridge power plant, increasing the output from 1000 hp to 1200 hp. Plans are also being made by the company for increasing the capacity of the Tallahassee Shoals plant.

BOISE, IDAHO.—It is expected that the transmission lines of the Beaver River Power Company will be extended from the Malad River power plant northward into Boise and through the Payette country by Oct. 1, 1911. The initial installation of the plant now being erected on the Malad River will have an output of 10,000 hp with an ultimate development of 20,000 hp. The plant is located about 7 miles from Bliss. The company has recently been granted franchises to supply electricity in Mountain Home and Glens Ferry. L. B. Fuller, of Provo, Utah, is vice-president of the company.

CALDWELL, IDAHO.—The installation of a municipal electric-light plant in Caldwell is reported to be under consideration.

COLCHESTER, ILL.—The Colchester Electric Light & Power Company, it is said, will probably rebuild its plant in the near future, which was recently burned. The company has been granted a twenty-year franchise.

HILLSBORO, ILL.—The Hillsboro Electric Light & Power Company has awarded the contract for construction of a new power house to J. T. Morgan and Frarer Brothers.

MINONK ILL.—The Union Light & Power Company, recently formed by the consolidation of the Minonk Electric Light & Power Company and Rutland Electric Light Company, is reported to have purchased the property of the Toluca Electric Light & Gas Company, of Toluca. The company is capitalized at $100,000 and the officers are: S. C. Kipp, of Minonk, Ill., president; F. Z. Ames, of Rutland, secretary, and J. S. Webber, of Rutland, treasurer.

ORANGEVILLE, ILL.—The installation of an electric-light plant in Orangeville is reported to be under consideration.

OTTAWA, ILL.—Orders have been placed by the Chicago, Ottawa & Peoria Railway Company with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for equipment for three substations having a capacity of 300 kw each. The company is building an extension from Morris to Joliet, a distance of 22 miles.

PEORIA, ILL.—The St. Louis, Springfield & Peoria Railway Company has contracted with the Westinghouse Electric & Manufacturing Company for equipment for two substations, one of 300 kw and the other of 500 kw capacity.

SPRINGFIELD, ILL.—Plans are being considered by the Springfield & Central Illinois Traction Company for extending its railway from Edwardsville to Greenville, to connect with the main line.

YORKVILLE, ILL.—Work has begun on the construction of a concrete dam by F. H. and George Simpson, who recently purchased the Millhurst water-power site. Negotiations are under way, it is said, for lighting the City of Plano.

SHERIDAN, IND.—The Town Council is reported to be negotiating with out-of-town parties with a view of selling the municipal electric-light plant, who, it is said, will install a new plant and lighting system.

VINCENNES, IND.—The Vincennes, Washington & Eastern Traction Company has awarded the contract for the construction of its proposed electric railway between Vincennes, Washington and Loogootee to the Canadian Construction Company.

BELLEVUE, IA.—Two Foos producer engines have been purchased for the municipal electric-light plant. Both engines are of the Foos three-cylinder vertical type and will develop 100 hp.

COUNCIL BLUFFS, IA.—The Commercial Club of Council Bluffs is advocating the installation of a municipal electric-light plant in Council Bluffs. A committee has been appointed by the club to investigate the feasibility of the plan and to secure estimates on the probable cost and operation of a plant of sufficient capacity to meet the present needs and also one of double the capacity. The cost of lighting the city last year was $20,472. The question of improving the present street-lighting system is under consideration. Dr. Donald McCrae is chairman of the special lighting committee of the club.

DE LAND, IA.—I. C. Bowsher is reported to have applied to the Village Board for a franchise to install and operate an electric-light plant in De Land.

WILTON, IA.—The local electric-light plant is reported to have been damaged by fire recently, causing a loss of about $3,500.

GARDEN CITY, KAN.—A special election will be held on August 1 to vote on the proposition to issue $40,000 in bonds, the proceeds to be used for the construction of a municipal electric-light plant in Garden City.

MANHATTAN, KAN.—The Public Utilities Commission has authorized the Manhattan City & Interurban Railway Company to issue $200,000 in bonds, the proceeds to be used to build an extension from Manhattan to Ft. Riley.

NESS CITY, KAN.—The electric-light and ice plant and mill, owned by the Ness City Mill, Light & Ice Company, was destroyed by fire on June 23, causing a loss of about $100,000.

SYLVAN GROVE, KAN.—At an election held June 26 the proposition to issue $35,000 in bonds, the proceeds to be used for the construction of an electric-light plant and water-works system, was carried.

SYKESVILLE, MD.—Sealed proposals will be received at the office of the Governor of Maryland, Union Trust Building, Baltimore, Md., until July 14 for the installation of equipment in the power house of the Springfield State Hospital at Sykesville, Md., consisting of boiler plant, engines, generators, switchboard and piping, according to plans and specifications prepared by Henry Adams, consulting engineer, 855 Calvert Building, Baltimore, Md.

CARLISLE, MASS.—The town of Carlisle has awarded a contract to the Edison Electric Illuminating Company of Boston for lighting the streets of the town for a term of ten years.

LUNENBURG, MASS.—The Leominster Electric Light Company is extending its transmission lines from the present terminus on Oak Avenue to the Dickinson place on the Northfield Road. A petition will soon be presented to the town officials asking for the extension of the street-lighting system over the same line.

MILFORD, MASS.—The Milford Electric Light & Power Company is installing two new generators and a switchboard in its power house. The gas service on Main Street is also being renewed.

PRINCETON, MASS.—At a town meeting held recently the citizens voted to authorize the electric-light committee to enter into a contract with the Roper Box Lumber Company to install a street-lighting system for a period of ten years. Under the terms of the contract the company is to supply fifty lamps at $20 each per year.

ROWLEY, MASS.—At a special town meeting held recently it was voted to extend the municipal electric-light system to the suburbs of the town and to appropriate the sum needed to pay the extensions.

BARAGA, MICH.—The Village Council is considering the question of installing a municipal electric-light plant and water-works system at an estimated cost of about $28,000. J. F. Pruer, of St. Paul, engineer, has been engaged to make preliminary surveys and prepare plans for same.

IRON MOUNTAIN, MICH.—Arrangements are being made by the Newton Construction Company, which has the contract for construction of the large dam at Twin Falls on the Menominee River, near Iron Mountain, for the Peninsula Power Company, to begin work on the same. It is understood that the Chicago, Milwaukee & St. Paul Railroad Company has agreed to build at once a short spur track from the main line to a point near the site of the dam.

SAGINAW, MICH.—Announcement has been made by the Pere Marquette Railroad Company of further improvements to its system, costing about $100,000, which will be made at once. A new power station with double the output of the present plant will be erected and 32-stall round houses will be built.

TROWBRIDGE, MICH.—The power house of the Commonwealth Power Company at Trowbridge was destroyed by fire, causing a loss of about $100,000. This plant has an output of 5000 kw and supplies electricity to Allegan, Otsego, Plainwell and Kalamazoo. It is said that the plant will be rebuilt.

DEERWOOD MINN.—The Cuyunna Range Light & Power Company is reported to be making arrangements to increase the output of its hydroelectric power plant, located near the Crow Wing River.

DULUTH, MINN.—The Suburban Street Railway Company is reported to have financed its proposed railway. It is understood that work will soon begin on the construction of suburban lines in Duluth. N. J. Upham, of Duluth, Minn., is interested in the company.

TOWER, MINN.—It is reported that arrangements are being made for the construction of a dam and electric plant at Like River, to cost from $12,000 to $15,000, bids for which will soon be called. D. A. Reed is engineer.

NEWARK, N. J.—Plans are being considered by the city officials and the Public Service Corporation for developing the water-power of the Pequannock River to generate electricity. The present plan is to have the city build a generating plant on the city property and sell the output of the plant to the Public Service Corporation or any other company utilizing electricity desiring the service. It is estimated that about 1000 hp can be developed. The project has been considered before with a view of supplying electricity in Newark, but it was found that the distance was too great to utilize the electricity generated at an advantage.

PASSAIC, N. J.—The Common Council has authorized the Mayor and public safety committee to engage an engineer to ascertain the cost of installation and maintenance of a municipal electric-light plant for Passaic, and also the cost of placing all wires on prominent streets under ground.

RED BANK, N. J.—The question of establishing a municipal electric-light plant in Red Bank is under consideration. The purchase of the local plant is contemplated.

DEMING, N. M.—P. E. Kern, of Deming, N. M., is interested in a project to establish a colony for a large development project around Iola, N. M., 20 miles south of Deming, in the Mimbres country. It is proposed to secure enough subscribers to develop 16,000 acres. The plan includes the installation of a central power plant with pumps and motors to irrigate half sections at a cost of $122,500. A committee, consisting of Mr. Kern, Ira P. Wetmore and Clarence V. Hon, has been appointed to inspect the different irrigating systems.

BINGHAMTON, N. Y.—Plans have been submitted to the Common Council by Electrical Engineer FitzGerald for the construction of an underground subway on Court Street, from Exchange Street to the bridge, the cost of which is estimated at $23,439. The plan provides for twenty-eight main ducts and ten laterals at a cost of $9,500; it also calls for six manholes, eighteen injunction boxes, forty-five service boxes used for branching conduits, eighty service boxes and for thirty-eight lamp posts and four police call posts. Provision has been made for ducts for the Binghamton Light, Heat & Power Company and four ducts for municipal electric wires in case a municipal plant is installed in the future, one duct for fire-alarm system, one for police-wire system and two ducts for boulevard lighting. It is the intention of the Binghamton company to carry its wires in a subway from the corner of Exchange Street up Court Street to its power plant.

BUFFALO, N. Y.—The Broadway Business Men's Association is considering the question of erecting electrically lighted arches along Broadway.

NORWICH, N. Y.—The Norwich Pharmacal Company, of Norwich, N. Y., it is reported, is contemplating building an addition to its factory building, now under construction, and the erection of a power house, 40 ft. x 80 ft., one story high.

ONEONTA, N. Y.—The contract for direct-connected engines and generators and switchboard for the State Normal School, Oneonta, N. Y., was awarded to the Troy Electric Company, of Troy, N. Y., at $2,977, and to the Conduit Electric Company, of Syracuse, N. Y., for feeder cables and interior electric light wiring, for $3,270.

POUGHKEEPSIE, N. Y.—The Public Service Commission, Second District, has granted the Central Hudson Gas & Electric Company permission to execute a mortgage for $5,000,000 to the Knickerbocker Trust Company, of New York, N. Y., and to issue at this time $600,000 in bonds, the proceeds to be used for proposed improvements. The company operates in Poughkeepsie, Newburg and Cornwall.

ROCHESTER, N. Y.—Arrangements have been made between the committee on lamps and electricity and the representatives of the Rochester Railway & Light Company and the New York Telephone Company, whereby the overhead wires in St. Paul Street and Clinton Avenue south will be removed within a year.

SYRACUSE, N. Y.—Orders have been placed by the Syracuse Rapid Transit Company with the General Electric Company of Schenectady, N. Y., for one 1000-kw rotary converter, three 350-kva transformers and a switchboard.

GASTONIA N. C.—The electric-power plant of the Spencer Mountain Power Company located on the Catawba River, about 7 miles from Gastonia, was destroyed by fire on June 24, causing a loss of about $20,000. It is understood that the plant will be rebuilt at once.

LISBON, N. D.—The Bemmels Milling Company is reported to be contemplating the installation of an electric plant to supply electricity for lamps and motors in Lisbon.

CINCINNATI, OHIO.—Proposals will be received by the Board of Trustees, Public Library, school district of Cincinnati, Ohio, until July 18, for rewiring the Public Library Building, 620 Vine Street, Cincinnati, Ohio, according to plans and specifications on file in the office of the clerk of Board of Trustees in the Public Library Building. Bids are to be addressed to R. H. West, chairman of the building committee.

DAYTON, OHIO.—The merger of the Dayton Lighting Company, the Citizens' Electric Company and the Dayton Light & Power Company has been consummated and the issue of $20,000,000 in capital stock authorized. The officers of the Dayton Lighting Company are: E. P.

Matthews, president; H. E. Talbott, treasurer, and F. M. Tait, vice-president, secretary and general manager.

IRONTON, OHIO.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 17 for the construction of United States post office at Ironton, Ohio, including plumbing, heating apparatus, electric conduits and wiring and lighting fixtures, in accordance with plans and specifications, copies of which may be obtained from the above office or from the custodian of site. James Knox Taylor is supervising architect.

TOLEDO OHIO.—The Auglaize Power Company, recently incorporated with a capital stock of $1,000,000, proposes to develop the water powers of the Maumee and Auglaize rivers and supply electricity in the counties of Lucas, Wood, Fulton, Henry, Williams, Defiance, Paulding and Putnam. The promoters of the new company are interested in the Ashley hydraulic plant recently completed on the Maumee River in Miami, which supplies part of the energy used by the Toledo Railways & Light Company. It is stated that the company proposes to build at least three hydroelectric power plants in northwestern Ohio, the first of which will be erected on the Auglaize River at Defiance, where water rights have been secured. About 3000 kw will be developed at this plant. The incorporators are: Robert R. Livingston, J. M. Ashley, Charles S. Ashley, Grant Miller and William P. Wallace, of Toledo.

GROVE, OKLA.—The citizens have voted to issue $35,000 in bonds, the proceeds to be used for the installation of an electric-light plant and water-works system in Grove.

PAWHUSKA, OKLA.—The proposition to issue $10,000 in bonds, the proceeds to be used for improvements and extensions to the electric-light system, will be submitted to a vote.

HALSEY, ORE.—The Oregon Power Company, of Albany, Ore., has been granted a franchise to construct and operate an electric-lighting system in Halsey.

KLAMATH FALLS, ORE.—The Medford River Electric Company, of Medford, Ore., has submitted a proposition to the City Council offering to supply electricity in Klamath Falls. The company offers to furnish the city with electric energy to be distributed by the city at a flat rate, or would be willing to operate under a franchise. If granted a franchise the company offers to make provision in the franchise giving the city the right at all times to regulate the rates to be charged for electricity and in addition would allow the city 5 per cent of the gross earnings of the company.

NEWPORT, ORE.—The Yaquina Electric Company, of Tacoma, Wash., recently incorporated, is planning to install an electric-power plant in Newport. Under its charter the company has the right to construct and operate electric railways and operate steamers.

EBENSBURG, PA.—Improvements are being made to the plant and system of the Ebensburg Light, Heat & Power Company. Most of the service will be changed from direct-current to alternating-current, heretofore both systems have been supplied.

IRWIN, PA.—The Borough Council has granted the Pittsburgh, McKeesport & Greenburg Railway Company a franchise to construct and operate an electric railway from Main Street to the west boundary line of the town connecting with the Trafford City extension of the Pittsburgh Railways Company.

LANCASTER, PA.—The Lancaster & York Furnace Street Railway Company is installing two 300-kw rotary converters in its power house.

MASONTOWN, PA.—Application has been made at Harrisburg for an extension of the West Penn Traction Systems through Masontown, Pa. to Morgantown, W. Va. The new railway will be known as the Masontown-Morgantown Street Railway Company. The first section will be built from Masontown to New Geneva, Pa., a distance of about 5 miles; later it will be extended to Point Marion, Pa., and ultimately to Morgantown. Plans are also contemplated by the West Penn Traction interests for extensions south from Masontown.

NEW CASTLE, PA.—An ordinance has been introduced to the City Council to call an election to submit the proposition to issue $500,000 in bonds to construct a municipal electric-light plant, sewage-disposal plant and for repaving and repairing streets, to a vote of the people. It is proposed to install an electric plant to cost about $200,000, a sewage-disposal plant, at a cost of $183,000, and to expend $117,000 for street improvements.

PHILADELPHIA, PA.—Plans have been completed for the erection of an electric plant for the Philadelphia Electric Company by John T. Windrim. The plant will be located at Twenty-sixth and Christian Streets, and will be used to supply extra power to the Philadelphia Rapid Transit Company. The cost of the plant complete is estimated at about $50,000.

PROVIDENCE, R. I.—The Gorham Manufacturing Company is installing additional boilers of 300 hp, erecting a new chimney and remodeling the steam mains; the heating plant is also being remodeled. C. E. Fairbanks is engineer in charge.

WASHINGTON, R. I.—At a meeting of the Washington lighting district held recently the committee was authorized to enter into a contract with the Narragansett Electric Lighting Company for lighting the district.

ANDERSON, S. C.—The Savannah Power Company is reported to be contemplating the installation of an auxiliary steam-power plant.

MOBRIDGE, S. D.—A franchise has been granted to the Mobridge Light & Heat Company to install an electric-light plant in Mobridge. The plant will be driven by steam power and an alternating-current, three-phase, 2300-volt, 60-cycle electric system will be installed. M. E. Brookman is engineer in charge. Messrs. Hill & Smith are owners.

YANKTON, S. D.—It is reported that the electric light plant of the Yankton Light, Heat & Power Company is being remodeled. It is proposed to establish a twenty-four-hour service.

CHATTANOOGA, TENN.—The Chattanooga Railway & Light Company has applied to the City Council for a franchise to extend its street railway system along Highland Park and Vance Avenue.

MEMPHIS, TENN.—A permit has been granted for the new power house for the new union passenger station to be located at South Second Street and Carolina Avenue. The building will be of brick and concrete construction and cost about $40,000.

BRYAN, TEX.—It is reported that the proposition to issue $20,000 in bonds to complete the electric-light plant, water works and sewer systems will be submitted to a vote.

BRYAN, TEX.—Rapid progress is being made on the power plant being erected for H. T. and J. S. Lawler, of New Orleans, La., in Bryan. It is expected to have the plant in operation by Aug. 1. The plant will supply electricity for lighting the city and operating the pumping system of the water works.

HARDWICK, VT.—Plans are being considered for increasing the output of the municipal electric light plant for which bonds to the amount of $65,000 has been voted. A dam 13 ft. high will be built above Jackson Bridge, about a mile from the village. The cost of building the dam is estimated at $24,000, new equipment $15,000 and land damages $20,000.

HYDE PARK, VT.—At a special village meeting held recently the Water and Light Commissioners were authorized to make improvements and extensions to the municipal electric-light plant, the cost not to exceed $7,500. The work will include the purchase of new machinery.

NORTH TROY, VT.—The Frontier Electric Company, recently incorporated with a capital stock of $30,000, it is said, will supply electricity in Orleans County and other parts of Vermont and Quebec.

ALEXANDRIA, VA.—The Alexandria Electric Company is reported to be contemplating remodeling and enlarging its power plant. It is understood that contracts have been placed for additional equipment. The company is planning to extend its transmission lines to various suburbs, including Virginia Highlands, Mount Ida and Braddock Heights. Francis R. Weller, Hibbs Building, Washington, D. C., will supervise the work.

LYNCHBURG, VA.—The contract for furnishing and installing lighting fixtures in the United States post office building in Lynchburg has been awarded to the Cassidy & Son Manufacturing Company, of New York, N. Y., for $2,525.

NEWPORT NEWS, VA.—At an election held June 24 the proposition to issue $150,000 in bonds, the proceeds to be used for construction of a municipal electric-light plant, was defeated.

SUMAS, WASH.—It is reported that the town of Sumas will issue bonds to the amount of $7,000, the proceeds to be used to install an electric-light and heating system.

KEYSTONE, W. VA.—The Appalachian Power Company is reported to have purchased the property of the Keystone Light & Power Company in Keystone.

WELCH, W. VA.—The property of the Welch Water, Light & Power Company is reported to have been sold to the Appalachian Power Company.

DE PERE, WIS.—The De Pere Electric Light & Power Company has awarded contract for deepening the tail race in the rear of its plant. The cost of the work is estimated at $5,000 and will increase the water-power available from 25 per cent to 30 per cent. Electricity for operating the local system will be obtained from the power plant at High Falls, with which the plant is connected.

MADISON, WIS.—The bill authorizing the Chippewa & Flambeau Improvement Company to construct and operate a system of reservoirs has passed the State Legislature. The proposed system is expected to regulate the flow of water at all seasons of the year so that the water-powers along these rivers will not be forced to stop during the low-water periods.

MILWAUKEE, WIS.—Mayor Emil Seidel has vetoed the resolution providing for the appropriation of $6,000 to engage engineers for preliminary work on the proposed municipal electric light plant, passed by the Council June 5. The reason for vetoing the bill was due to its being illegal, owing to the appropriation having been made before the fund was created.

NEW LISBON, WIS.—Bids will be received by W. S. Sargent, city clerk, until July 19 for the construction of an electric-light plant and water-works system. A Meyer, of Appleton, Wis, is engineer.

LETHBRIDGE, ALTA., CAN.—It is reported that additional equipment will be installed in the municipal electric-light plant to supply electricity to operate the proposed street-railway system in Lethbridge. The apparatus will include four boilers, an electrical generating unit and steam-driven exciter, a motor generator, switching apparatus and extension to present economizer and coal conveyor.

MACLEOD, ALTA,, CAN.—It is reported that the by-law to appropriate $46,000 for extensions to the municipal electric-light plant and water-works system will be submitted to the voters. E. F. Brown is town clerk.

WAINWRIGHT, ALTA., CAN.—The installation of a municipal electric-light plant in Wainwright is reported to be under consideration.

WETASKIWIN, ALTA., CAN.—It is reported that preparations are being made for the installation of additional equipment in the municipal electric-light plant, including a gas-engine-driven generator and a motor-driven air compressor.

VERNON, B. C., CAN.—Bids will be received by the city of Vernon, B. C., Can., until July 10 for furnishing and installing one 200-kw, three-phase, 2200-volt, 60-cycle generator, together with two-panel switchboard and exciter complete. Specifications and form of tender may be obtained at the office of the city superintendent. D. G. Tate is city clerk.

BEAMSVILLE, ONT., CAN.—A movement has been started by the residents of the district between Hamilton and Beamsville, Ont., to secure electrical service from the distributing system of the Hydro-Electric Power Commission. It is expected that a substation will be erected at St. Ann's to supply this territory.

OTTAWA, ONT., CAN.—It is reported that American and English capitalists are interested in the erection of an electric smelting plant to be located at Chat Falls, about 20 miles west of Ottawa, work on which will begin early next spring. It is proposed to build an electric railway from the falls to the mines.

OWEN SOUND, ONT., CAN.—The Town Council is contemplating securing hydroelectric power either from Niagara Falls, by the way of Guelph, or from the lately acquired Severn plant. The Council has communicated with the Hydro-Electric Power Company with a view of ascertaining the approximate cost and opportunity of securing the service.

MONTREAL, QUE., CAN.—The Isle au Heron Development Company, recently incorporated, is reported to be contemplating a power development at the Lachine Rapids.

MOOSE JAW, SASK., CAN.—Proposals will be received by W. F. Heal, city clerk, until July 24 for electrical apparatus as follows: Contract A—50 6.6-amp., direct-current, series-metallic, flame-arc lamps, with globes, etc.; fifty absolute cut-out hangers; current regulator for fifty-lamp circuit; one mercury rectifier for fifty-lamp circuit; one control panel with switches for fifty-lamp circuit. Contract P—fifty ornamental lamp standards. Plans and specifications may be obtained from J. P. Peters, electrical superintendent.

WATROUS, SASK., CAN.—Contracts have been placed by the town of Watrous with the Brydges Engine & Supply Company for the installation of an 82-hp gas engine, 90-hp suction gas producer and a 50-kw generator for the municipal electric-light plant.

New Industrial Companies.

THE AMERICAN ELECTRICAL MANUFACTURING COMPANY, of Los Angeles, Cal., has filed articles of incorporation, with a capital stock of $500,000. The incorporators are: R. Mansard, J. E. Seeley and others.

THE ARTHUR MACHINE COMPANY, of Richwood, Ohio, has filed articles of incorporation, with a capital stock of $20,000, to manufacture gasoline engines. The incorporators are: George W. Arthur, C. E. Zieg, E. J. Tobey, H. J. Brooks and M. W. Arthur.

ASHTON, LAIRD & COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $25,000, by W. E. McDonnell, E. R. Rosenbaum and A. B. Malcomsen, all of New York, N. Y. The company proposes to manufacture welding apparatus, vehicles, motors, engines, etc.

THE DAYTON-DICK COMPANY, of Quincy, Ill., has been incorporated by H. F. Dayton, A. B. Dick and C. E. Epler, all of Quincy, Ill. The company is capitalized at $30,000, and proposes to manufacture motors, engines and machinery.

THE DUFFY & BOYD HARDENED COPPER COMPANY, of Gardiner, Maine, has been incorporated, with a capital stock of $100,000, by James H. Duffy, John Boyd, of Togus, Maine; C. A. Messer, of Gardiner, Maine. The company proposes to manufacture electrical and other machinery and appliances, especially the hardened copper trolley wheel invented by James H. Duffy. C. A. Messer is president and John Boyd treasurer of the company.

THE ELECTRIC OMNIBUS CORPORATION, of Albany, N. Y., has been incorporated by A. J. Parker, Jr., for the purpose of manufacturing electrical omnibuses.

THE WILLIAM S. HAMILL COMPANY, of Troy, N. Y., has been granted a charter with a capital stock of $25,000 to do a general engineering and contracting business. The incorporators are: W. S. Hamill, M. S. Geyer and J. C. Hamill, all of Troy, N. Y.

THE INDIANAPOLIS GAS ENGINE COMPANY, of Indianapolis, Ind., has been chartered, with a capital stock of $10,000, by Thomas Strack, W. P. Best, H. A. Noffke, Ray Carmichael and B. N. Lay. The company proposes to manufacture gas engines.

THE INGLEWOOD GAS & ELECTRIC FIXTURE COMPANY, of Inglewood, Cal., has been incorporated, with a capital stock of $10,000, by E. B., B. S. and L. R. Raymond.

THE INLAND SUPPLY COMPANY, of Danville, Ill., has been granted a charter, with a capital stock of $35,000, to manufacture machinery and motors. The incorporators are: H. C. Yelon, O. Finney and G. Harroun, all of Danville, Ill.

THE LAKE CHARLES CONSTRUCTION COMPANY, of Lake Charles, La., has been incorporated, with a capital stock of $25,000, for the purpose of dealing in and installing electric light and gas fixtures. The officers are: J. Stuart Thomson, president; A. Brammer, vice-president, and Frank V. Gallagher, secretary and treasurer.

E. S. LINCOLN, Inc., of Brookline, Mass., has been incorporated, with a capital stock of $130,000, to deal in electrical supplies. The incorporators are: E. S. Lincoln, of Brookline, Mass., president, and H. B. Sherman, of Newtonville, Mass., treasurer.

THE LYRACHORD COMPANY, of Yonkers, N. Y., has been incorporated, with a capital stock of $150,000, to manufacture electric pianos. J. T. Gibson, 232 Washington Avenue, Yonkers, N. Y., is managing director.

THE NEW YORK MAGNAPHONE & MUSIC COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,000,000 by George R. Webb, Charles A. Benton, Josiah L. Blackwell, Benjamin Natkins, Adelbert R. Whaley and Oliver W. Doty, all of New York, N. Y., and Henry W. Webb, of Baltimore, Md. The company proposes to maintain a system of electric telephone for general telephone business and the distribution of music from New York to Buffalo, passing through Albany, Syracuse, Rochester and intermediate cities.

THE PARK ELECTRIC COMPANY, of Detroit, Mich., has been organized by Lewis G. Coleman and Edward C. Jarchow. The company proposes to do a general electrical contracting business in Highland Park. The place of business will be located on Woodward Avenue Highland Park.

THE PEERLESS ENGINEERING COMPANY, of New York, N. Y., has been chartered by Elder P. DeTurk, 4241 Broadway; Charles F. Dussler, 346 East Eighty-fifth Street, and George R. Leib, 4241 Broadway, all of New York, N. Y.

THE SAN DIEGO IGNITION COMPANY, of San Diego, Cal., has been incorporated by H. A. Brown and C. B. McMaster, of San Diego, Cal. The company proposes to manufacture electric signs and to repair and care for electric motors.

THE SPHINX MOTOR COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $600,000. The incorporators are: Harry W. Davis, of Wilmington, Del.; Graham Faster and William H. Turner, both of New York, N. Y.

THE SPRING MOTOR FAN COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $500,000. The incorporators are: F. R. Hansell, of Philadelphia, Pa.; G. H. Martin and S. C. Seymour, of Camden, N. J.

THE STALEY ELECTRIC ELEVATOR & MACHINE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000 to manufacture and deal in elevators and hoisting apparatus, etc. The incorporators are: Marcellus Staley, 245 Bay Tenth Street, Brooklyn, N. Y.; Judson J. Staley, 1838 North Twenty-second Street, Philadelphia, Pa., and Herman Moskowitz, 1748 Park Avenue, New York, N. Y.

THE STATES COMPANY, of Syracuse, N. Y., has been incorporated by Roger H. and H. A. Blakeslee, of Hartford, Conn., and Henry J. Blakeslee, of Syracuse, N. Y. The company is capitalized at $50,000, and proposes to manufacture electrical instruments and appliances. The office of the company is located at 202 West Water Street, Syracuse, N. Y.

THE UNITED STEAM UTILITIES CORPORATION, of Manhattan, N. Y., has been chartered with a capital stock of $30,000 by F. C. Farnsworth, of Brooklyn, N. Y.; F. M. Patterson, of Jersey City, N. J., and J. H. Allen, of New York, N. Y. The company proposes to manufacture and sell valves, steam traps, etc.

THE WICKECHECKE CORPORATION, of Trenton, N. J., has been incorporated, with a capital stock of $125,000, by T. C. Kitchin, M. E. Green and L. W. Skelton, of Trenton, N. J. The company proposes to do a general civil, mechanical, electrical and hydraulic engineering business.

THE W. T. ELECTRIC COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000 to manufacture and deal in mechanical and electrical specialties. The incorporators are: B. P. Wiltberger, of New York, N. Y.; E. E. Trafton, of Portland, Maine, and C. McC. Chapman, of New York, N. Y.

New Incorporations.

BERRYVILLE, ARK.—The North Arkansas Power Company has been incorporated with a capital stock of $100,000 to develop the water power in the streams of Northern Arkansas to generate electricity. The directors are J. R. Neff, president; E. H. Ingram, Ellis D. Munger and W. D. Wilton.

ELBERTON, GA.—The Elberton & Eastern Railway Company has been chartered, with a capital stock of $50,000, by W. O. Jones, W. F. Anderson, J. H. Blackwell, J. M. Heard, R. L. Cauthen and J. Z. Rogers. The company proposes to construct and operate an electric railway between Elberton, Tignall, Washington and Lincolnton.

ROCKFORD, ILL.—The Northwestern Telephone & Telegraph Company has been granted a charter with a capital stock of $30,000 to construct and operate a telephone and telegraph exchange.

BERWICK, MAINE.—Articles of incorporation have been filed for the Power & Light Securities Company with a capital stock of $100,000. The officers are: W. Thompson, president, and F. A. Hobbs, treasurer and clerk, both of South Berwick, Maine.

BAY SPRINGS, MISS.—Articles of incorporation have been filed for the Bay Springs Electric Company with a capital stock of $10,000 by C. E. Burnham, L. L. Denson, E. A. Denson and others.

JEFFERSON CITY, MO.—Articles of incorporation have been filed for the St. Louis, Arcadia & Jefferson City Railway Company by T. J. Portis, Charles F. Vogel, E. F. Kinney, T. A. Hildebrandt, R. M. Hamlin, all of St. Louis, Mo., and H. D. Mackey, of Springfield, Mo. The company is capitalized at $250,000 and proposes to build an interurban railway extending from Russell Place, St. Louis, to Fenton, Mo., a distance of 15 miles.

INDIANOLA, NEB.—The Farmers' Creek Telephone Company has been chartered with a capital stock of $9,000 by A. O. Olson, W. H. Noone and E. H. Gilbert.

CHAUMONT, N. Y.—The Chaumont Electric Light Company has been granted a charter with a capital stock of $8,000. The incorporators are: Edgar H. Merriman, of Adams Center; Charles N. Arnold and George Diefendorf, of Chaumont, N. Y.

PORT EWEN, N. Y.—The Call Electric Light & Power Company has filed articles of incorporation with a capital stock of $200,000 to construct and operate electric-light and power plants. The incorporators are: Henry J. Eder, 251 Ninety-fifth Street, New York, N. Y.; Edward H. Mason, 1105 Marquette Building, Chicago, Ill., and P. J. Eder, 80 William Street, New York, N. Y.

DENNISON, OHIO.—Articles of incorporation have been filed for the Twin City Traction Company by Ralph E. Westfall, Smith N. G. Bennett, M. R. Thornton, H. Miller and W. M. Huffman. The company is capitalized at $100,000, and will take over property of the United Electric Company, which supplies electrical service in Dennison and Uhrichsville and operates an electric railway between the two towns.

JOHNSTOWN, OHIO.—Articles of incorporation have been filed for the Johnstown Water & Light Company, with a capital stock of $6,000, by M. R. Thornton and others.

WARREN, OHIO.—Articles of incorporation have been filed for the Trumbull Public Service Company with a capital stock of $10,000 by C. C. Ewens, Ellis R. Diem, Harold T. Clark, Clarence E. Sanders and Sterling Newell. The company proposes to erect electric and gas generating plants and drill for water and gas and to supply electricity, gas and water in various towns and cities in Trumbull and Geauga counties.

CLATSKANIE, ORE.—Articles of incorporation have been filed for the Clatskanie Electric Light & Power Company.

GRANT'S PASS, ORE.—The Jackson County Light & Power Company has filed articles of incorporation with the Secretary of State for the purpose of building an electric railway between Grant's Pass and Ashland, Ore.

BIGLERTOWN, PA.—The Conewago & Southern Railroad Company has been incorporated by H. W. Hamblin, of Harrisburg, Pa., president; M. A. Garvin and J. J. Garvin, of Gettysburg, and others. The company is capitalized at $150,000 and proposes to build an electric or steam railroad between Biglerville, Arendtsville and Cashtown.

CROYLE, PA.—The Croyle Township Light, Heat & Power Company has been granted a charter, with a capital stock of $5,000. The directors are: Albert Stineman, of South Fork, Pa., president; J. Wilbur Stineman and O. M. Stineman, all of South Fork, Pa.

LEWISBURG, PA.—The Citizens' Electric Company has filed articles of incorporation with a capital of $15,000. The directors are John P. Ruhl, of Lewisburg, Pa., treasurer; Harold McClure, C. Willard Oldt, Henry Stahl, John T. Judd, Willmer R. Follmer and Cloyd Steinger, all of Lewisburg, Pa.

NEW CASTLE, PA.—The Republic Railway & Light Company has filed articles with the Secretary of State at Trenton, N. J. The company is capitalized at $17,500,000, and proposes to do a general electric, gas, heat, light and power business. It will also take over the Mahoning & Shenango Railway & Light Company, with a capital stock of $10,000,000, which controls and operates many public utility companies in western Pennsylvania and eastern Ohio.

PITTSTON, PA.—The Pittston Heat, Power & Light Company has been incorporated, with a capital stock of $150,000, by James H. Shea, 299 East South Street, Wilkes-Barre, Pa., and C. W. Miller. The former is treasurer.

MEMPHIS, TENN.—The Lunda Light Company has been incorporated with a capital stock of $5,000 by P. F. Lunda, N. W. Lunda, W. L. Fisher and others.

CLARENDON, TEX.—Articles of incorporation have been filed for the Clarendon Light & Power Company, with a capital stock of $25,000, by L. W. Chase, A. L. Chase and W. M. Odell.

WACO, TEX.—The Waco Gas & Electric Company has been granted a charter with a capital stock of $500,000. The incorporators are: J. F. Strickland, O. Goodwin and M. B. Templeton, all of Dallas, Tex.

WACO, TEX.—The Waco Street Railway Company has been incorporated with a capital stock of $1,000,000 by J. F. Strickland, O. Goodwin and M. B. Templeton, all of Dallas, Tex.

JUNCTION, UTAH.—The Piute County Electrical Company has been chartered, with a capital stock of $12,000, for the purpose of operating an electric lighting system in Piute County. The officers are: M. M. Steel, president; Fred Miner, vice-president, and Joseph Steele, secretary and treasurer.

BYRDVILLE, VA.—The Mebane-Virginia Land & Water Power Company has been incorporated with a capital stock of $225,000. The officers of the company are: M. K. Harris, of Danville, Va., president; J. D. Harrison, vice-president, and S. H. Marshall, of Spray, N. C., secretary and treasurer.

WENATCHEE, WASH.—Articles of incorporation have been filed for the Wenatchee Traction Company with a capital stock of $250,000 by Louis W. Pratt, president; J. R. Askew, W. M. Harvey, Henry Hewitt, Jr., and A. A. Hilton.

CHARLESTON, W. VA.—The Charleston-Dunbar Traction Company has been granted a charter with a capital stock of $150,000. The company proposes to build an electric railway from Charleton to Dunbar. The incorporators are: Fred Paul Grosscup, Paul B. Grosscup, W. C. Davidson and H. D. Rummell, all of Charleston, W. Va.

VANCOUVER, B. C., CAN.—The Grouse Mountain Scenic Incline Railway Company has been granted a charter with a capital stock of $750,000. The proposed road will be near Vancouver and will cost about $520,000.

Personal.

MR. CHARLES O. AUSTIN, who for the past three years has been city electrician of Bangor, Maine, has resigned that office to take a position at Presque Isle, Maine, with the Maine & New Brunswick Electric Power Company.

MR. ALEXANDER MACOMBER, of the engineering staff of the Tenney Syndicate, and formerly assistant to the electrical engineer, has been appointed engineer of the electric department for these properties, with headquarters at 201 Devonshire Street, Boston.

MR. F. B. SILSBEE has been awarded the degree of Master of Science by the Massachusetts Institute of Technology, his thesis having for its subject the effect of frequency on the permeability of iron. Mr. Silsbee has joined the staff of the National Bureau of Standards at Washington.

MR. F. C. SARGENT, formerly electrical engineer for the Tenney Syndicate, which controls and operates a number of gas and electric companies in New England and New York, has become engineering manager for these properties, with headquarters as formerly at 201 Devonshire Street, Boston.

MR. E. O. SCRIVEN, a graduate of Beloit College, has received from the Massachusetts Institute of Technology the degree of Master of Science, his thesis having been on the subjects of the effects of high frequency and on the multi-gap lightning arrester. Mr. Scriven has entered the employ of the American Telephone & Telegraph Company.

MR. J. P. HART has received from the Massachusetts Institute of Technology the degree of Master of Science. Mr. Hart is a graduate of the United States Naval Academy and the University of Kansas. His thesis was on the subject of the internal reactance of steel rails. Mr. Hart has entered the employ of the Southern Pacific Railroad Company at San Francisco.

MR. CHARLES R. STOVER, a graduate of the Pennsylvania State College, has received the degree of Master of Science from the Massachusetts Institute of Technology. Mr. Stover's thesis was on an investigation on the reflection of light from walls and ceilings, including an investigation of the cubical photometer, which produced some interesting results. Mr. Stover will go with the National Electric Lamp Association at Cleveland.

MR. HUGH PATTISON has been appointed electrical engineer of the influential committee on electrification of terminals organized by the Chicago Association of Commerce. This committee, of which Mr. Horace G. Burt is chief engineer, will make a study of the proposed electrification of the railroad terminals of Chicago. Mr. Pattison, who will enter on his new duties on Aug. 1, is exceptionally well qualified for the position, as he has been superintendent of construction for the extensive Pennsylvania Railroad terminal electrification in New York.

MR. R. L. JONES has received the degree of Doctor of Engineering from the Massachusetts Institute of Technology, of which he was a graduate. His studies leading to the degree related particularly to alternating-current theory and the transmission of energy, electrochemistry, organization and administration of public-service companies, and mathematics. His research thesis work was on the subject of heat treatment

of transformer steel. By using an induction electric furnace he was able to carry on some interesting and important investigations, from which results believed to be of value were obtained. Mr. Jones has entered the employ of the Western Electric Company in its division of research and development.

MR. E. M. WHARFF, for the past two years superintendent of overhead construction and track bonding of the Syracuse, Lake Shore & Northern and South Bay Railways, has resigned to accept a position with the operating engineering department of the Illinois Traction System at Peoria, Ill., in connection with work on efficient operation of electric plants, gas plants and electric railways. Mr. Wharff, after having been for five years with the Beebe system of electric railroads in central New York as apprentice, became electrical engineer of the Syracuse, Lake Shore & Northern Railroad and the Syracuse & South Bay Electric Railroad in charge of power houses and substations, cars and car shops and overhead work, and later superintendent, as stated above, during which latter period he was engaged particularly in building catenary overhead work.

MR. GEORGE H. WHITFIELD, who has been for many years general superintendent of the lighting and traction properties at Richmond, Va., has recently given up his work of management to devote himself more particularly to consulting engineering. In the latter capacity he will be retained for all the Gould properties in Virginia, including the plants at Richmond, Petersburg, Norfolk and Fredericksburg. Mr. Whitfield was graduated from Richmond College in 1892, and from Cornell University in 1896, with the degree of M. E. He went at once into the street-railway field and became superintendent of shops for the United Railways of Baltimore in 1899, remaining there until 1901. He was also general superintendent for a year of the San Francisco and San Mateo road, during which period negotiations were pending that resulted in the formation of the United Railroads of San Francisco. On going to Richmond in 1902, Mr. Whitfield found a large opportunity waiting for him, including the enlargement of power houses, the erection of substations, construction of transmission lines to Petersburg, construction of new cars, the installation of hydraulic and steam turbines and the elimination of electrolysis from the water-pipe system of Richmond. In addition, Mr. Whitfield engaged in the designing of the electrical feature of the plants of the Emporia Hydro-Electric Company and the Richmond and Chesapeake Bay Railway Company.

Trade Publications.

COUPLINGS.—In Bulletin No. 4818, just issued by the General Electric Company, are described that company's flange couplings and flexible couplings.

ALTERNATING-CURRENT SWITCHBOARD PANELS.—The General Electric Company has recently issued Bulletin No. 4846, which contains such information as will enable the prospective customer to select intelligently the switchboard panels best suited to his needs.

ELECTRICALLY OPERATED GOLD DREDGES.—Bulletin No. 4833, recently issued by the General Electric Company, describes a number of installations of electrically operated gold dredges and contains information which should be of great interest to all connected in any way with this industry.

COMMUTATING POLE GENERATORS.—Bulletin No. 4832 of the General Electric Company describes a line of commutating pole generators in which, it is claimed, commutating trouble is eliminated. These generators are built for slow and moderate speeds, range in capacity from 20 kw to 150 kw, and are wound for 125 volts, 250 volts and 575 volts. They may be equipped with sliding base or with belt tightener as may be desired.

CABLE JOINTS ON UNDERGROUND HIGH-TENSION LINES.—Bulletin No. 52 of the Minerallac Electric Company, 400 South Hoyne Avenue, Chicago, is devoted to a description of the method of making high-tension underground cable joints by the use of the materials and plan of operations devised by the company. The bulletin contains several illustrations and is an interesting addition to the literature of practical construction work.

FLOW METERS.—The General Electric Company has just issued a publication describing another of its flow meters, which, in this instance, is designed for measuring the flow of steam. Two forms of the steam-flow meters are manufactured, one for recording and the other for merely indicating the flow. This meter resembles somewhat the air and water meters manufactured by this company, and is fully illustrated and described in this publication, which is No. 4836.

CURTIS STEAM TURBINES.—The General Electric Company has just issued Bulletin No. 4845, containing illustrations and descriptive matter in considerable detail of its horizontal steam turbine generators of from 100-kw to 1000-kw rating at 3600 r.p.m., which is the maximum speed possible for use with 60-cycle alternating-current generators. These units are particularly adapted to industrial and lighting plants requiring economical generation of a moderate amount of power.

ELECTRIC LOCOMOTIVES FOR INDUSTRIAL RAILWAYS.—Bulletin No. 4829 of the General Electric Company has for subject the electric locomotive as adapted to fulfil the transportation requirements of all industries, for which uses it possesses many advantages over steam locomotives, animal haulage, hand trucks, etc. Locomotives designed especially for use in this connection are described, these locomotives being built for both standard and narrow gage, and in various styles.

BUSINESS NOTES

MR. FRANK W. HALL, manager of the Philadelphia office of the Sprague Electric Works, has been appointed manager of hoist sales, and after July 15, 1911, will be located at the New York office.

SALE OF LOMBARD GOVERNORS.—During the month of June the Lombard Governor Company, Ashland, Mass., sold governors to regulate 73,350 hp of water-wheels. This business was scattered over the entire country from Maine to California, and included the governing of water-wheels of nearly every make.

APOLLO PERPETUAL CALENDAR.—The demand for the Apollo all-metal perpetual calendar issued by the American Sheet & Tin Plate Company, Frick Building, Pittsburgh, Pa., has been so great as to make it necessary to issue a new edition. A copy of this will be forwarded upon application from an electrical engineer or dealer.

MR. JAMES A. CLIFFORD, manager of the Baltimore office of the Sprague Electric Works, has been appointed manager of the Philadelphia office and took charge there on July 1, 1911. The Baltimore office will be continued as in the past under Mr. Clifford's direction, but as subsidiary to the Philadelphia office, and with Mr. Henry S. Patterson in charge.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, Ill., manufacturer of high-tension specialties, has moved to 617-631 West Jackson Boulevard, where increased manufacturing and office facilities have been secured. In addition to high-tension devices, a complete line of high-efficiency "Mazda" lighting units have been developed and were placed on the market July 1.

MR. ALFRED H. COATES, president of the Colonial Electrical Agency Company, of San Francisco, Cal., expects to leave early in July on his annual Eastern trip. He will spend some time in Warren, Ohio, at the headquarters of the Colonial Electric Company and the Economy Electric Company, both of which concerns are represented on the Pacific Coast by Mr. Coates' company.

F. N. MANROSS & SONS, manufacturers of hair springs at Forestville, Conn., have recently made extensive additions to their plant to meet rapidly increasing business, which has continuously grown since it was established by Mr. F. N. Manross in 1880. On Jan. 1 of this year Mr. Manross admitted into partnership his two sons, Arthur N. and Robert H., thus relieving Mr. Manross, Sr., of a great deal of detail which his rapidly increasing business entailed. The product of this company is used for electrical recording and measuring instruments, clocks, watches, and steam gages, and a close attention to this particular line of work has resulted in building up a trade which now extends to foreign countries, and the plant now enjoys the distinction of being one of the largest exclusive hair-spring factories in the world. The manufacture of these delicate springs requires most careful attention, and expert labor is necessary. All the tools used are designed and built in the factory. The springs are made in silver, bronze, brass and other metals, as well as the highest grade of imported cast steel, some of the material used to meet the exacting requirements of electrical measuring instruments costing as high as $200 per pound.

NEW SANGAMO BUILDING.—The Sangamo Electric Company has erected at Springfield a new building, 160 ft. x 40-42 ft., two stories high, of steel, brick and concrete construction. The south end of the lower floor is used for packing and shipping room, instrument-testing room and generator room. The north end downstairs is a machine and tool room and pattern shop. The entrance is through a large hall having on one side a fireproof vault for the storage of master patterns, master plates, records, etc. The south half upstairs is devoted to assembling and general testing rooms and the north half is divided into a general office, private offices and a drafting room, the offices being finished in dark paneling and light rough plaster above. The floors throughout are narrow hard maple. The new building is connected on the second floor by a passageway to the two-story old main building, which is 180 ft. x 30 ft., the upper floor of which is now devoted entirely to light manufacturing work, such as the manufacture of coils, recording trains, small brass and steel parts, etc., and to inspection and storage of finished light material. The lower floor contains machinery for heavy manufacturing, such as milling machines, drill presses, heavy turret lathes, hydraulic presses, punch presses, receiving room and storeroom for raw material. A brick building north of the old main building is the forge shop, 85 ft. x 30 ft., and japanning room, being equipped with fuel, oil furnaces, Bliss presses, disk grinders, etc., for the manufacture of all types of permanent magnets, and with very complete equipment of gas-heated ovens for japanning and baking insulating varnish. A smaller building to the north is used for the manufacture of molded insulation parts, being equipped with grinding machinery and hydraulic presses up to 250 tons capacity. The grounds occupied by the buildings and available for additional buildings are about 2¼ acres in extent. The factory is situated about 1½ miles from the center of the city, and is reached by two car lines.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 27, 1911.

[Prepared by Robert S. Allyn, of New York.]

996,068. ELECTRIC SNAP SWITCH; C. J. Dorff, Chicago, Ill. Filed Oct. 3, 1910. Two-button push arranged to insure complete movement of contact even upon partial manual operation of a button.

996,069. TRAIN-INDICATING APPARATUS; J. B. Edings, Macon, Ga. Filed Sept. 20, 1909. A clock device with a plurality of hands controlled by a central operator.

996,088. COMBINED WIRE AND WIRELESS TELEPHONE SYSTEM; M. B. Johnson, San Antonio, Tex. Filed Oct. 6, 1910. Grounded "wireless" instruments are connected with wire lines so that conversation may be carried on between two wire-line circuits separated for instance by a river.

996,089. COMBINED WIRE AND WIRELESS TELEGRAPH SYSTEM; M. B. Johnson, San Antonio, Tex. Filed Oct. 6, 1910. A message is transferred automatically from a wire line to a wireless system, the wireless transmission mechanism being under the control of the operator at the remote wireless station.

996,090. WIRELESS-TELEPHONE SYSTEM; M. B. Johnson, San Antonio, Tex. Filed Oct. 6, 1910. A ground circuit in condition for receiving and transmitting messages without change.

996,091. SPARK-GAP MUFFLER; M. B. Johnson, San Antonio, Tex. Filed Oct. 6, 1910. Concentric glass cylinders to muffle the noise of discharge in wireless work, etc.

996,092. BOX FOR CARRYING WIRELESS SIGNALING APPARATUS; M. B. Johnson, San Antonio, Tex. Filed Oct. 6, 1910. A two-compartment box to be carried by hand or strap.

996,094. METHOD OF MAKING FUSIBLE COMPOUNDS OF ALUMINUM AND RECOVERING ALUMINUM THEREFROM; L. R. Keogh, Ottawa, Canada. Filed Aug. 22, 1908. Adds anhydrous sulphate and carbonaceous material to a compound of a metal more electropositive than aluminum and heating to reaction and reducing electrically.

996,120. SIGNALING ATTACHMENT FOR SPEEDOMETERS; W. J. Norton, Denver, Col. Filed Aug. 4, 1909. For automobiles. Displays a signal upon reaching a certain selected speed.

996,143. COMMON-BATTERY LOCK-OUT TELEPHONE SYSTEM; H. J. Roberts, Evanston, Ill. Filed Oct. 22, 1908. Special signaling lock-out and selector relays are employed to eliminate inductive effects, maintain signaling connections, prevent interference, successively extend the circuits, facilitate inter-party conections and maintain supervision.

996,218. BRUSH-HOLDER SUPPORT; C. T. Crocker, Norwood, Ohio. Filed June 5, 1905. A bracket for the brush holder is fastened inside the motor casing by means accessible from outside.

996,253. DYNAMO-ELECTRIC MACHINE; F. A. Johnson, Colorado Springs, Col. Filed Jan. 9, 1911. A part of the face of the field pole is eccentric to the armature and a shiftable member is interposed to prevent distortion and shifting of the commutating field.

996,266. THREE-WIRE DYNAMO-ELECTRIC MACHINE; C. E. Lord, Milwaukee, Wis. Filed June 7, 1909. An improvement on Dobrowolsky 513,006 to simplify the rotor and maintain a balanced voltage.

996,267. ELECTRICALLY OPERATED HOISTING APPARATUS; F. E. Lutz, Philadelphia, Pa. Filed June 8, 1909. A three point switch and circuits for limiting the movement of machinery propelled by electric motors.

996,268. INCANDESCENT LAMP; D. G. MacDonald, Sydney, N. S., Canada. Filed July 11, 1910. Multiple filaments with terminal bands arranged on a tubular stem and a switch.

996,270. STATOR-COIL SUPPORT; E. Mattan, Norwood, Ohio. Filed Jan. 31, 1907. The end turns of chain windings are secured to the sides of insulating bracing members to prevent vibration.

996,273. FUSE HOLDER; R. C. Millard, Atlanta, Ga. Filed Feb. 19, 1910. A combustible strip of paper serves as an indicator.

996,279. ALARM; J. A. Bobinson, Denver, Col. Filed March 2, 1908. A fire and burglar-alarm attachment for a telephone.

996,280. HIGH-TENSION DISCHARGE APPARATUS; E. J. Rose, Los Angeles, Cal. Filed June 28, 1909. For direct or alternating current and to produce oscillatory current of differing character.

996,303. SCREWLESS SPRING CONTACT; H. Wilhelm, New York, N. Y. Filed Feb. 18, 1909. Wire springs are strung through the base without screws and operated by a push button.

996,312. INSULATOR; T. D. Childress, Ansted, W. Va. Filed Sept. 27, 1910. Special shaped base and cap members for telephone, telegraph, etc., wires.

996,331. PROJECTOR CONTROLLER; J. L. Hall, Schenectady, N. Y. Filed Dec. 14, 1908. Remote control of searchlights to follow the line of sight.

996,334. DRIVING DYNAMOS FROM VARIABLE AND NON-VARIABLE SOURCES OF POWER; C. D. Haskins, Schenectady, N. Y. Filed Aug. 5, 1908. A prime mover such as an internal combustion motor is arranged to compensate for variations in power derived from variable sources such as windmills and car axles.

996,335. FIRE-PROTECTION DEVICE; R. B. Hewitt and J. G. Nolen, Chicago, Ill. Filed May 29, 1903. The riser of an automatic fire-extinguisher system has a float operated by the movement of water, which float modifies an electric circuit to give the alarm.

996,336. CIRCUIT-CONTROLLING SWITCH; C. H. Hill, Schenectady, N. Y. Filed Jan. 13, 1909. A starting switch is operated step by step. An interlocking device prevents the circuit-breaker from being closed before the switch is in starting position.

996,344. ELECTRICALLY CONTROLLED SAFETY APPLIANCE FOR RAILWAYS; R. T. and F. T. Jones, Baltimore, Md. Filed Oct. 15, 1909. A heating device for keeping a signal rail clear of snow and sleet.

996,350. HOT-WATER BOTTLE; D. P. Lamb, Portland, Ore. Filed Sept. 21, 1910. A rubber "bottle" has a chamber for an incandescent electric light bulb.

996,371. VAPOR ELECTRIC APPARATUS; W. F. Sneed, Schenectady, N. Y. Filed Sept. 11, 1908. A mercury-arc rectifier lamp has reactance which is reduced for starting.

996,372. SYSTEM OF ELECTRICAL DISTRIBUTION; C. F. Steinmetz, Schenectady, N. Y. Filed Oct. 25, 1905. A core transformer is used in conjunction with a rectifier having a plurality of main anodes, a mercury cathode and a starting anode.

996,373. OSCILLATING ELECTRIC SWITCH; G. E. Stevens, Lynn, Mass. Filed Aug. 20, 1909. A pendent shell with a sliding button on the lower end.

996,376. NEUTRALIZING INDUCTIVE DISTURBANCES; J. B. Taylor, Schenectady, N. Y. Filed July 28, 1906. An artifical condenser and a transformer are connected between a single-phase trolley wire and an aerial signal conductor to impress upon the latter a balancing electrostatic charge.

996,377. ELECTRIC MEASURING INSTRUMENT; E. Thomson and R. Shand, Lynn, Mass. Filed Dec. 12, 1906. To indicate instantaneous value of current or emf in direct-current circuits. The pointer has a long and uniform scale and the moving element is damped to secure dead-beat.

996,379. REGULATOR FOR STORAGE BATTERIES; A. A. Tirrill, Schenectady, N. Y. Filed Dec. 14, 1907. Special winding of the booster to regulate charging and discharging.

996,381. MAGNETIC SHIELD FOR ELECTRIC MACHINES; H. H. Wait, Chicago, Ill. Filed Feb. 11, 1907. The retaining bands of a high-speed generator are shielded to avoid heating by eddy currents.

996,387. SWITCH FOR ELECTRIC CIRCUITS; G. Wright, Pittsfield, Mass. Filed Nov. 8, 1904. Oil-immersed contacts. Type of patent 761,745. Special form of contacts and arrangement.

996,388. MOTOR-CONTROLLING DEVICE; C. E. Zix, Berlin, Germany. Filed March 27, 1908. For reversible hoist motors, etc. A plurality of two position interrupting switches normally in series and a double-pole reversing switch.

996,390. MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. Filed Jan. 5, 1910. To cause series motors to operate as braking generators to return energy to the source.

996,391. KEINFORCER FOR TELEPHONE CIRCUITS; E. F. W. Alexanderson, Schenectady, N. Y. Filed Jan. 6, 1910. To increase intensity without affecting quality, and inductor alternator with a winding common to its field and armature has its field connected to the telephone circuit. The armature circuit is a closed local containing a condenser and is tuned to resonance.

996,392. ARC LAMP; J. H. Allen, Chicago, Ill. Filed March 16, 1906. A thermostatic rod short-circuits the lifting magnet to protect it against abnormal currents.

996,393. CIRCUIT-BREAKER; C. C. and I. F. Badeau, Bethlehem, Pa. Filed Dec. 10, 1906. Has an underload armature and an auxiliary armature adapted to mechanically engage with it under no-load.

996,394. SWITCH OR CIRCUIT-OPENER FOR HIGH-POTENTIAL CIRCUITS; C. C. Badeau, Bethlehem, Pa. Filed Aug. 8, 1908. May be opened or closed from any desired point.

996,406. ELECTRIC WELDING MACHINE; J. L. Hall and A. Metzger, Schenectady, N. Y. Filed April 1, 1907. Particularly for tubing and tanks having long joints. One or more arcs are arranged to travel back and forth automatically.

996,408. ELECTRIC-LIGHT SOCKET; T. E. Hamby, Rockwood, Tenn. Filed Feb. 14, 1911. A switch to operate without jar.

996,414. CONTROLLING SYSTEM FOR REVERSING MOTORS; S. H. Keefer, Plainfield, N. J. Filed Nov. 2, 1910. Prevents operation of certain switches after current is cut off from the motor until the armature ceases rotation; prevents reversing while the motor armature is driven by momentum of the work as in machine tools.

996,420. MANUFACTURE OF LAMP FILAMENTS; J. T. Marshall, Metuchen, N. J. Filed May 22, 1908. A carbon filament after the first firing is oxidized and roughened by electric current in air before the usual flashing in benzine vapor and final firing to prevent the "metalized" coating from slipping.

996,429. ARC LAMP; A. Schellenberger, Berlin, Germany. Filed July 2, 1908. Feed control of converging electrodes.

996,439. ELECTRIC HAMMER; H. F. Whalton, Key West, Fla. Filed Nov. 22, 1910. Two sliding electromagnets; reversible action; current is reversed after blow is struck.

996,440. ELECTRIC HAMMER; H. F. Whalton, Key West, Fla. Filed Nov. 22, 1910. Two solenoids in tandem.

996,445. TELEPHONE RELAY AND SYSTEM; E. F. W. Alexanderson, Schenectady, N. Y. Filed Nov. 11, 1909. This is a reinforcer of the type of Patent No. 902,195 and shows special arrangements of the high-frequency alternator windings.

996,454. ELECTRIC HEATER; A Carpenter, Tacoma, Wash. Filed Nov. 12, 1910. A combination heater and fireless cooker.

996,460. RETURN-INDICATION DEVICE FOR ELECTRIC INTERLOCKING SYSTEMS; F. B. Corey, Schenectady, N. Y. Filed Sept. 24, 1908. For motor-driven track switches. To prevent the return indication magnet from being actuated by fluctuating direct current.

996,474. FRACTIONAL DISTILLATION OF METALS; C. C. Fink, Schenectady, N. Y. Filed Feb. 7, 1908. Antimony and arsenic ores. The charge is heated and pressure reduced.

996,475. BRUSH FOR DYNAMO-ELECTRIC MACHINES; W. C. Fish, Lynn, Mass. Filed Sept. 11, 1909. The carbon brush has an aluminum holder with radiating vanes for cooling.

996,489. TELLTALE FOR ELECTRIC LIGHTS; J. F. Key, Washington, D. C. Filed Dec. 30, 1908. Particularly for ships, to indicate any failure of the running lights.

996,492. ELECTRIC MELTING AND REDUCTION FURNACE; H. B. Lorentzen, Notodden, Norway. Filed April 20, 1911. Special feed channels.

996,500. AUTOMATIC EXCHANGE SYSTEM; W. H. Matthies, Antwerp, Belgium. Filed Nov. 12, 1910. The selectors are advanced and switched over the same circuit, by changing the resistance of a closed circuit and by opening the circuit respectively.

996,501. ELECTRIC-ARC LAMP; L. C. H. Mensing, Edinburgh, Scotland. Filed Oct. 28, 1910. Improvement in the carbon magazine of Patent No. 881,015.

996,515. FLEXIBLE PROTECTOR FOR ELECTRIC CABLES AND LIKE PURPOSES; E. L. Pease, Darlington, England. Filed May 6, 1910. Sinuous strips having registering flanged apertures provide the conductor path.

996,529. SYSTEM OF MOTOR CONTROL; W. T. Sears and S. H. Keefer, Philadelphia, Pa. Filed Oct. 28, 1910. A pilot switch governs the starting, stopping and reversing of a drive motor and a feed motor for machine tools.

996,551. ELECTRICALLY CONTROLLED CLOCK AND TIME-INTERVAL TRANSMITTER; H. J. Aiken, San Francisco, Cal. Filed Dec. 9, 1909. For artillery fire-control system, etc.

996,571. DYNAMO-ELECTRIC MACHINE; E. A. Edwards, Cincinnati, Ohio. Filed Nov. 30, 1901. Means for preventing sparking at the brushes.

996,579. ELECTRICAL CONDUCTOR; H. Geisenhöner and F. L. Stone, chenectady, N. Y. Filed Mch. 1, 1905. A tubular metal rivet secures a flexible conductor to a carbon brush.